

Flora Malesiana

Volume 3 – 1998

Polypodiaceae
Davalliaceae
Azollaceae
Cheiropleuriaceae
Equisetaceae
Matoniaceae
Plagiogyriaceae



Series II – Ferns and Fern allies

Cover: *Davallia trichomanoides* Blume, Cameron Highlands, Peninsular Malaysia.
Photograph H.P. Nootboom, 1998.

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Polypodiaceae

(P. H. Hovenkamp et al. — pp. 1–234)

Davalliaceae

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Azollaceae

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Cheiropleuriaceae & Equisetaceae

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Plagiogyriaceae

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Publisher's Note

Starting with Flora Malesiana Vol. 13 of Series I, the subdivision of the volumes into parts have been abandoned. It has appeared that hardly anywhere, not even in libraries, the parts are bound together into the thick volumes we were familiar with in the beginning of the project. Every issue, covering one or more families, will now be called a volume.

ABSTRACT

Flora Malesiana. Series II, volume 3 (1998) vi + 1–334, edited by C. Kalkman† and H.P. Nootboom, published by Rijksherbarium/Hortus Botanicus, Leiden, The Netherlands, under the auspices of Foundation Flora Malesiana.

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Contains taxonomic revisions of seven families of Ferns and Fern allies for Malesia, i.e. the area covering the countries Indonesia, Malaysia, Brunei Darussalam, Singapore, the Philippines, and Papua New Guinea.

P.H. Hovenkamp (with contributions by M.T.M. Bosman, E. Hennipman, H.P. Nootboom, G. Rödl-Linder, and M.C. Roos), **Polypodiaceae**, pp. 1–234.

The family, worldwide in distribution, is represented in Malesia by 18 genera and 183 species. Many species are epiphytic, and the family contains some of the most striking as well as some of the most abundant epiphytes of the Malesian area. Its representatives form a significant part of the vascular epiphytic flora of both the lowland and the mountain forests. *Platyserium* (staghorn ferns) is of considerable horticultural interest, and the association of ants with the genus *Lecanopteris* is ecologically interesting.

The general part of the family treatment also includes a paragraph on spore morphology by G.A. van Uffelen.

The systematic account is to a large extent based on the monographs and character analyses carried out by Hennipman and co-workers. As circumscribed here, in Malesia the following genera are represented: *Aglaomorpha* (with 14 species), *Arthromeris* (1), *Belvisia* (6), *Christiopteris* (2), *Drynaria* (7), *Goniophlebium* (13), *Lecanopteris* (13), *Lemmaphyllum* (2), *Lepisorus* (4), *Leptochilus* (6, including *Colysis*), *Microsorium* (30, including *Phymatosorus* and *Neocheiropteris*), *Paraselliguea* (1), *Platyserium* (6), *Podosorus* (1), *Polypodiopteris* (3), *Pyrrosia* (23), *Selliguea* (49), *Thylacopteris* (2). The genus *Loxogramme*, often included in Polypodiaceae, is here considered to belong to a separate family Loxogrammaceae.

Family, genera and Malesian species are described and annotated, in all but a few cases exclusively on the basis of Malesian material. Keys to the genera and species are given; in some cases separate regional keys are presented. One new combination is made on p. 13: *Aglaomorpha acuminata* (Willd.) Hovenkamp (basionym: *Acrostichum acuminatum* Willd.).

Illustration is by 31 line drawings, of which 18 are full-page.

H.P. Nooteboom, **Davalliaceae**, pp. 235–276.

A family of which several species are cultivated as ornamentals. Short paragraphs on the distribution and chromosome numbers are included.

The family is represented in Malesia by three genera, *Davallia* (23 species), *Davalodes* (6), and *Leucostegia* (2). A key to the genera and for each genus a key to species are included. SEM photographs of the sori of *Davallia* are given, as well as photographs of a herbarium sheet of one species of each genus.

R.M.K. Saunders, **Azollaceae**, pp. 277–284.

This nearly cosmopolitan family with only one genus and 6 or 7 species is represented in Malesia by one species, *Azolla pinnata* R. Br. The general part of the treatment includes paragraphs on reproduction, fossils, phylogeny, vegetative and reproductive structures and life cycle, chromosomes, uses, and taxonomy. The family and the Malesian species are described, and a drawing of the plant and details of the reproductive structures is given.

J.E. Laferrière, **Cheiropleuriaceae**, pp. 285–286.

A description is given of the family and its only species, *Cheiropleuria bicuspis* (Blume) Presl, with a drawing of the habit of the species.

J.E. Laferrière, **Equisetaceae**, pp. 287–288.

A description is given of the family which has only one genus with c. 15 species. In Malesia only one subspecies is found, *Equisetum ramosissimum* Desf. subsp. *debile* (Vauch.) Hauke, which is described. A drawing of habit and details is given.

M. Kato, **Matoniaceae**, pp. 289–294.

In this family two genera are distinguished, *Matonia* and *Phanerosorus*, with two species each. The family is restricted to Malesia. Family, genera, and species are described and annotated and keys to genera and species are included. Habitat and ecology, taxonomy and affinity, and fossils are discussed. One line drawing is given.

X.C. Zhang & H.P. Nooteboom, **Plagiogyriaceae**, pp. 295–316.

A description is given of the family which has only one genus, *Plagiogyria*, with 11 species. In Malesia 7 species occur, one of which, *P. egenolfioides* (Baker) Copel., with 4 varieties. The general part of the treatment covers 4 pages and includes paragraphs on distribution, ecology and morphology. The family and its species and varieties are described and annotated. A key to the species is included. Four photographs of herbarium sheets have been reproduced.

Index to scientific plant names of taxa treated in this volume (accepted names and synonyms) on pp. 317–332.

Lists of revised families in Flora Malesiana on pp. 333–334.

POLYPODIACEAE

(P. H. Hovenkamp et al.¹, Leiden, The Netherlands)

Polypodiaceae Berchtold & J. Presl, Pfl. Rostlin. 1 (1820) 272; Ching, Sunyatsenia 5 (1940) 257; Copel., Gen. Fil. (1947) 174; Holttum, Revis. Fl. Malaya 2 (1955) 129; Copel., Fern Fl. Philipp. (1960) 453; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 203. — Type genus: *Polypodium*.

Platyneriaceae Ching, Sunyatsenia 5 (1940) 256. — Type genus: *Platynerium*.

Drynariaceae Ching, Acta Phytotax. Sin. 16 (1978) 1. — Type genus: *Drynaria*.

Rhizome creeping, dorsiventral, with two alternating dorsal rows of phyllopods and two alternating lateral rows of buds; scales basifixed, pseudopeltate to peltate, clathrate or isotoechous, margin entire to ciliate. Anatomy: ground tissue parenchymatous or rarely sclerenchymatous, with or without strands of sclerified cells, stele dictyostelic, composed of 3–many vascular strands, with or without a sclerified circumvascular sheath. *Fronds* often dimorphic, articulated to the phyllopods, sessile to stipitate, erect or appressed, simple to pinnate, pedately or dichotomously divided, rarely bipinnatifid, often covered with deciduous or persistent scales or hairs. *Veins* forked, free (rarely) to copiously branched and anastomosing. Fertile areas often contracted, frequently on separate fronds. *Sori* exindusiate, rounded, transversely or longitudinally elongated or forming irregular acrostichoid patches, sporangia short- to long-stalked, capsule with vertical, interrupted annulus, soral trichomes similar to the laminar ones or modified, sometimes more persistent, acicularsporangial trichomes sometimes present. Spores mostly 64 (rarely 8, 16 or 32), monolet.

DISTRIBUTION

Polypodiaceae are distributed worldwide, with the greatest diversity in tropical areas, especially in Asia. Most American species belong to the tribe *Polypodieae*, which is poorly represented in other areas. Very few genera bridge the gap between Old World and New World. Of the Malesian genera, only *Platynerium* is represented by one species in tropical South America.

HABITAT AND ECOLOGY

Most Malesian species are obligatory epiphytic, many are facultatively epilithic or terrestrial, and then often on earth banks. Few species are restricted to other habitats, such as regularly submerged rocks. One species (*Microsorium pteropus*) may grow permanently submerged. The altitudinal range of the *Polypodiaceae* stretches from sea level to nearly 4000 m in some species of *Selliguea*, but the greatest diversity in species is reached at intermediate altitudes, between 1000 and 3500 m.

1) Authors of the revisions of the 17 genera treated in this family have been mentioned directly under the genus names concerned. Almost all original drawings are by Mr. J.H. van Os and Mr. J.J.A.M. Wessendorp (L).

FOSSILS

Although many fossil remains have been described as Polypodiaceous, very few of these fall within the circumscription of *Polypodiaceae* used here. Macrofossils accepted as Polypodiaceous by Van Uffelen (1991) are recorded from the Miocene from California, the Pliocene from Germany, the Paleogene from Russia, and the Tertiary, possibly the Miocene, from Sumatra. The latter fossil is a frond fragment which clearly belongs to the Drynarioid ferns and has been assigned to *Drynaria quercifolia* and to *Aglaomorpha heraclea*. Dispersed spores cannot be reliably identified with *Polypodiaceae* in the current circumscription.

Reference: Uffelen, G.A. van, Fossil Polypodiaceae and their spores. *Blumea* 36 (1991) 253–272.

TAXONOMY

The family *Polypodiaceae* is here taken in an even more restricted sense than in Hennipman et al. (1990), i.e., excluding *Loxogrammaceae*. Considering that the differences between *Loxogrammaceae* and *Polypodiaceae* are of approximately the same magnitude as those between *Grammitidaceae* and *Polypodiaceae*, this seems to be the best solution, reflecting the uncertain affinities between these three families.

The generic delimitations here follow those in Hennipman et al. (1990), except for the genera *Colysis* (here included in *Leptochilus*), *Phymatosorus* and *Neocheiropteris* (here included in *Microsorium*), *Goniophlebium* (here treated as a separate genus), and the recently separated *Paraselliguea* (Hovenkamp 1997).

Hennipman et al (l.c.) also give details on morphology and anatomy. More details can be found in the various revisions and character analyses that have been used as a basis for this treatment (Sen & Hennipman 1981; Hennipman & Roos 1982; Hetterscheld & Hennipman 1985; Roos 1985; Van Uffelen & Hennipman 1985; Hovenkamp 1986; Ravensberg & Hennipman 1986; Baayen & Hennipman 1987a, b; Hennipman & Verduyn 1987; Hovenkamp 1990; Van Uffelen 1990, 1992, 1993; Rödl-Linder 1990, 1994a, b; Bosman 1991; Hovenkamp & Franken 1993; Hennipman in Gay et al. 1994; Nooteboom 1997; Hovenkamp 1997; 1998a, b).

From a diagnostic point of view the following characters are important:

Rhizome — Rhizomes can be very short, producing compact clusters of fronds, or long-trailing, forming extended clones with scattered fronds. Short-creeping rhizomes have the phylloids close together or contiguous, but in long-creeping rhizomes the internodes between the phylloids may be 10 cm long or longer. The rhizomes are usually terete, but sometimes distinctly dorsiventrally flattened. Highly modified rhizomes occur in *Drynaria* and *Aglaomorpha* (strongly thickened), and in *Lecanopteris* (modified to form ant-containing structures). Roots may arise from all sides, or be restricted to the ventral side; very rarely roots are absent. Anatomy: In cross sections various patterns of sclerification can often be seen. Sclerification may occur in the form of a subepidermal sclerified sheath (most frequently seen in *Platyserium* and *Pyrrosia*), of elongated sclerenchyma strands, the distribution of which as seen in cross sections is sometimes diagnostic; or of sheaths around the vascular strands. Combinations of two or more types of sclerifications occur. In some cases, the number

and pattern formed by the vascular strands is diagnostic. To examine the sclerification of a rhizome, it is usually sufficient to make an oblique cut with a sharp knife and examine the cutting face with a hand lens. This technique is also applicable to mounted specimens.

For the description of rhizomes, the following terms are more or less loosely applied: 1) short-creeping = phylloids close together, not separated by more than their own width; 2) medium-creeping = phylloids separated by usually 1–10 times their own width; 3) long-creeping = rhizomes elongated, the phylloids usually separated by more than 10 times their own width.

Rhizome indument — The indument of the rhizome may consist of scales or rhizoid-like hairs, often both. Characters of the scales are of great importance for the diagnosis of both genera and species. Structurally, scales may be more or less distinctly clathrate, with thickened cell walls forming a distinct lattice-pattern, or 'isotoechous', the cell walls all more or less equally thickened, not forming a clear lattice. The central cells of both types of scales may be more strongly thickened, forming a more or less distinct midrib. The marginal cells usually have thinner walls, and may form a distinct hyaline margin, also in otherwise clathrate scales. The margin of the scales may be entire to variously dentate, or more or less densely set with long, curly cilia. In some cases the presence or absence of small, two-celled glands is diagnostic, but these are usually only visible under a microscope at high magnification ($\times 100$). Particularly in the microsorioid group, the surface of the scales may bear a tuft of rhizoid-like hairs, usually situated directly on the point of attachment of the scale. This, however, is often not a constant feature, and may possibly be suppressed when the rhizome grows on the surface of the substrate. Rhizoid-like hairs may also occur scattered over the scale. Scales may be attached to the rhizome at their basal side (basifixed) or by a short, centrally or excentrically attached stalk (peltate). An intermediate state, termed 'pseudopeltate', occurs when a basally attached scale has large, overlapping auricles. Under superficial examination this is difficult to distinguish from the peltate state. To distinguish the two states it may be necessary to examine a detached, intact scale with high magnification under transmitted light with a compound microscope.

Fronds — Fronds are mostly simple or pinnately divided. Irregularly dichotomously divided fronds are characteristic for *Platyserium*. Simple fronds are predominant in *Pyrrisia* and the leporioid ferns, pinnately divided or trilobed fronds occur in most other genera. Only rarely fronds are more than once pinnate or pinnatifid. Frond dimorphy is common, and may take different shapes. The most common form of dimorphy is between sterile and fertile fronds, with fertile fronds having a narrower lamina. A less common form is the dimorphy between nest-forming fronds and foliage fronds in *Platyserium* and *Drynaria*. Both types of dimorphy may also occur within a single frond ('internal dimorphy'), between sterile and fertile parts, or between nest-forming parts and foliage parts (*Aglaomorpha*). Frond segments may be firmly attached to the rachis, or a more or less distinct abscission layer or node may be present, along which the segments can be shed. In species with dissected fronds, simple forms frequently occur.

Mostly the fronds are stipitate, although a decurrent lamina may obscure the presence of a stipe. Characteristically, the stipe is articulated to the rhizome, and the fronds are shed, although in drynarioid ferns the articulation between frond and rhizome is often not functional, and the rachises of the fronds may be retained long after the frond segments have been shed.

Lamina indument — A characteristic indument of stellate hairs occurs in *Platycerium* and *Pyrrosia*. In most other genera the lamina appears mostly naked, although with microscopic examination small, appressed glands turn out to be nearly always present. A distinct indument of multicellular, uniseriate hairs is present in several species. The density of these hairs may vary considerably within these species, possibly as a result of differences in habitat conditions, or differences in the life-cycle stage. Characteristics of the indument are best observed on the abaxial (lower) surface, as the indument on the adaxial (upper) surface is usually sparse, caducous or completely absent. Unless stated otherwise, all descriptions of lamina indument refer to the abaxial surface of the fronds.

Venation — Venation, in the Malesian polypodiaceous ferns, is always anastomosing. In other aspects there is much variation (see, e.g., Hettterscheid & Hennipman 1985; Hovenkamp 1986; Bosman 1991; Nooteboom 1997). For descriptive purposes, the following terms are applied throughout this treatment. In contrast to the accepted terminology using terms like 'primary', 'secondary' and 'tertiary' veins, these terms are intended to be as independent of the degree of frond dissection as possible, facilitating the comparison of the lamina of simple fronds to segments of dissected fronds. Using this terminology, it also becomes possible to use the same terms in describing simple and dissected forms of the same species.

Rachis — The continuation of the stipe, in a pinnate or pinnatifid frond.

Costa — The main vein of a lamina element (be it an entire lamina or a pinna), running parallel to the margin.

Veins — The veins running from the costa to the margin.

Connecting veins — The veins connecting the veins, thus enclosing primary areoles.

Veinlets — The veins branching from the connecting veins, be they simple, forked or anastomosing.

Free veinlets — the ultimate, free branches of the venation pattern. Recurrent, excurrent or without preference.

In some genera, mainly in the microsorioid group, dromy-patterns provide specific characters. To observe the dromy, the direction of the first branch of the veins (usually forming the connecting vein) must be assessed. In some cases this first branching point is obscured by a thick midrib; in that case the pattern is usually clearer near the apex of the segments.

Anadromous — The first branching of a vein directed towards the apex of the segment.

Catadromous — The first branching of a vein towards the base of the segment.

Sori — Sori are naked or covered with deciduous scales when young. They may take various shapes, ranging from small, round, separate sori to elongated, continuous coenosori or irregular, acrostichoid patches. In the larger genera (*Pyrrosia*, *Selli-*

guea, *Microsorium*), nearly the entire range of variation can be found, and attempts to form groups on the basis of a particular soral disposition nearly invariably lead to unnatural groups (e.g., *Drymoglossum* in the old sense, possibly also *Leptochilus* in the current sense). The formation of coenosori parallel to the margin is always accompanied by a reduction in lamina width, leading to a strong sterile/fertile dimorphism. Sterile paraphyses between the sporangia are common, mostly in the form of uniseriate hairs. More complicated structures also occur, often obviously representing slightly modified forms of scales or hairs also present on the sterile lamina (Baayen & Hennipman 1987a, b).

Sporangia — Sporangia are usually globose and stalked, with a vertical, interrupted annulus. The length of the stalk, the shape of the capsule, the number of indurated annulus cells and the presence of sporangial paraphyses all provide some diagnostic characters for a few species. Otherwise, the structure of the sporangia appears to be uniform.

Spores — Spores of *Polypodiaceae* are monolete, in shape varying from ellipsoid to fusiform. The inner wall layer, the exospore, is usually rather homogeneous but is in many species traversed with microchannels. Its surface sculpturing varies from completely smooth to strongly rugate. In many species the visible contours are fully dependent on the outermost wall layer, the perispore. This layer, present in all species, varies from very thin and inconspicuous to thick and prominently developed into various types of sculpture. Common elements appear to be the lamellar structure of the basal layer, which in thin perispores may be the only layer present, and the presence of spherical globules. The material of these globules appears to be different from that of the perispore, and more similar to that of which the exospore is composed. They are enveloped or completely incorporated in the perispore, and especially in the species with thin perispores, the globules often the only sculptural elements. Rounded elements, which appear to be composed of perisporal material, may occur in *Drynaria* and *Selliguea*.

From a taxonomic point of view, the spores clearly delimitate a group of genera around *Lepisorus* (*Belvisia*, *Lepisorus*, *Lemmaphyllum*). Some elements in the genus *Microsorium* appear to be linked to this group. On the basis of spore sculpture, a close relationship is also suggested between the drynarioid ferns and the genera *Selliguea*, *Arthromeris* and *Polypodiopteris* (Van Uffelen 1993).

Illustrated surveys and discussions of the spores of the *Polypodiaceae* are presented by Hennipman (1990), Van Uffelen (1990, 1992, 1993), Van Uffelen & Hennipman (1985), and Tryon & Lugardon (1991).

Aglaomorpha — The Malesian species have spores of two types (see Roos 1985): 1) Perispore thick, verrucate, with spines continuous with the perispore on top of the elements; this type occurs in *A. meyeniana*, *A. cornucopia* and *A. coronans*. 2) Perispore thin, inconspicuous (following exospore sculpture), variably set with small globules, in all other species.

Arthromeris — Spores of the one Malesian species are not known. In other species the perispore is thick, verrucate, set with spines continuous with the perispore in vari-

able densities. In cross sections, the sculpture elements of the perispore often contain cavities. These spores appear to be very similar to those of *Aglaomorpha meyeniana*.

Belvisia — Exospore strongly rugate and distinctly banded in cross section, with many transverse channels. Perispore very thin, globules infrequent. Van Uffelen (1992) has studied the development of this type of spore in detail.

Christiopteris — Exospore smooth. Perispore thin, the globules in varying density.

Drynaria — In the Malesian species, two types can be recognised (Roos 1985).

1) Exospore not or very lightly sculptured, perispore with a thin but strongly sculptured basal layer and spines continuous with it ('*quercifolia*'-type). The spines often give the impression of being formed of fused droplets. In some species (not Malesian) spines are absent, but globular structures are present. Unlike those that occur in many other species, these are continuous with the perispore, and often are of the same material (perhaps containing smaller globules of exosporeal material?). Van Uffelen (1990) has studied the development of this type of spores in detail.

2) Exospore coarsely rugate, perispore thin, unsculptured, spines or globules absent (only *D. pleuridioides*). Spores with a sculptured exospore and a thin perispore but with globules or spines similar to those of the first type are reported from outside Malesia.

Goniophlebium — Exospore smooth or colliculate, perispore with prominent, usually longitudinal, ridges (transverse ridges enclosing more or less isodiametric areas in *G. prainii*), confluent at the poles, often forming low protrusions there. Long protrusions (about equally long as the spore) are only found in *G. korthalsii*. Perispore in cross section appearing fibrous, sometimes enclosing globules of apparently exosporeal material.

Lecanopteris — The exospore in all species studied is smooth and featureless, the laesura short or very short (sometimes less than 1/4 the length of the spore).

The close association of this genus to ants may have led to a number of specific adaptations in the spores. There appears to be unanimity about the fact that the presence of large oil-bodies in the spores of *L. sinuosa* and *L. carnosa* is one such adaptation, stimulating dispersal by ants. Another specialisation present in this genus is the tendency for spores to be shed in clusters. In species of subg. *Lecanopteris* the spores often hang together in clusters of four. The spores of these species are often distinctly fusiform, with an inconspicuous featureless perispore, but perispore material forms a prominent flaky mass near the laesura, which connects the four spores of a single tetrad. In three species of subg. *Myrmecopteris* (*L. sinuosa*, *L. lomarioides*, *L. crustacea*) the spores are more ovoid in shape, with a perispore with scattered, flattened tubercles, sometimes containing globules. In the fourth species of this subgenus, *L. mirabilis*, the spores hang together in clusters of 16 or more, by way of a mass of tangled, very long filaments of perisporeal material. Whether or not these spore clusters are also an adaptation connected to the ant-fern association has been a matter of some dispute (Tryon 1985; Walker 1985; Van Uffelen 1985).

Lemmaphyllum — Spores of this genus are indistinguishable from those of *Belvisia*.

Lepisorus — Spores are similar to those in *Belvisia*, although the degree of sculpturing of the exospore is more variable: the spores of *L. mamas* are nearly smooth.

Leptochilus — Exospore lightly sculptured or smooth. Perispore thin, set with globules and, in *L. macrophylla*, with irregular spines composed of perisporeal material. The surface of the spines is warty, unlike that in *Drynaria* or *Selliguea*. Spines are absent in *L. axillaris*, no observations have been made on the other species.

Microsorium — Spores in this large genus vary considerably. The only common element appears to be the thin, adhering, basal layer of the perispore. In general shape, the spores vary from ellipsoidal (in most species) to fusiform (most strikingly in *M. samarense*).

The exospore is smooth in many species, but distinctly rugate in the species around *M. scolopendria* (e.g., *M. papuanum*). A coarsely rugate exospore similar to that of *Lepisorus* is found in *M. ensatum* and *M. superficiale*; and in *M. membranifolium* the exospore surface varies from smooth to finely pitted.

The perispore is variably ornamented with globules. The density of these globules varies considerably, sometimes within one species. They are notably absent in *M. scolopendria* and *M. papuanum*, giving the spores of these species a distinct appearance. In *M. membranifolium* and the closely related *M. rubidum* the perispore ornamentation consists of small globules and short, conical spines which appear to be composed of a different type of material.

Platyserium — Exospore mostly featureless, rarely shallowly and finely sculptured. Perispore thin, with varying numbers of globules. *Platyserium coronarium* and the closely related *P. ridleyi* have a flaky perispore, covered with dense, more or less spine-like structures.

Podosorus — No reliable data have been obtained from the single specimen by which this genus is known.

Polypodiopteris — Exospore smooth, perispore thick, colliculate, with conical or more elongated spines like those in *Selliguea* or *Drynaria*.

Pyrrosia — Van Uffelen & Hennipman (1985) give a complete survey of the spores of *Pyrrosia*. The exospore is smooth or nearly smooth in all Malesian species. The perispore is extremely variable, ranging from very thin (*P. princeps* and related species) to thick and with a complicated sculpture, consisting of ridges or verrucae, and sometimes (*P. piloselloides*) distinctly of two different types. The spores with a thin perispore are similar to those of many other species. The spores with ornamented perispores are mostly very characteristic for the groups that are recognised in *Pyrrosia*; while the similarity of the spores with longitudinal ridges (e.g., in *P. angustata*) to those of *Goniophlebium* is a parallel development.

Selliguea — Exospore plain, sometimes colliculate. Perispore composed of a thick basal layer, which is granulate, colliculate, sometimes rugulate with a finer or coarser pattern. Elongated or conical spines or globular structures occur in highly variable density. They are attached to and continuous with the basal layer. The spines appear to be massive and composed of perisporeal material, but it is uncertain whether the globules contain a spherical body of non-perisporeal material or not. Often they appear

to be accreting into spines or irregular structures. In species where the ornamentation mainly consists of long spines, the latter are often concentrated near the ends of the spore, in other species the density of the elements is often higher near the laesura. In some cases there are visible transitions between globules and the sculpture elements of the basal layer. Perispore sculpture appears to be of limited systematic value within the genus.

Thylacopteris — Exospore shallowly sculptured. Perispore thin, lamellate, with globules.

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KEY TO THE GENERA

- 1a. Lamina covered with stellate hairs 2
- b. Lamina with (sometimes umbrella-shaped) scales, simple hairs, or glabrous 3
- 2a. Lamina simple, sori round or linear **Pyrrosia** (p. 147)
- b. Lamina variously dichotomously divided, sori forming large spreading patches **Platycterium** (p. 133)
- 3a. Venation open, if anastomosing, then with 1–3 rows of areoles without included veinlets or with a single excurrent included veinlet, the lamina pinnately divided 4
- b. Venation anastomosing, forming a complex, reticulate pattern, recurrent free veinlets usually present 6
- 4a. Venation open **Thylacopteris** (p. 231)
- b. Venation anastomosing 5
- 5a. Rhizome scales fully clathrate (widespread) **Goniophlebium** (p. 44)
- b. Rhizome scales not clathrate, or indistinctly clathrate in the acumen only (Borneo) **Polypodiopteris** (p. 144)
- 6a. Ant ferns with swollen, hollow or laterally expanded rhizome, rhizome scales appressed, peltate and rounded; or very small or absent **Lecanopteris** (p. 59)
- b. Not ant ferns, rhizome not hollow or expanded, if strongly thickened then rhizome scales elongated 7
- 7a. Rhizome scales at least partly clathrate 8
- b. Scales on rhizome and/or fronds isotoechous (not clathrate) 17
- 8a. Sporangia in elongated coenosori 9
- b. Sori round or elongated, but not forming coenosori 12
- 9a. Fertile fronds or frond parts wide, with transverse coenosori **Leptochilus** (p. 81)
- b. Fertile fronds or frond parts narrowed, with longitudinal coenosori 10
- 10a. Fronds monomorphic, coenosori on an apical narrowed frond part ('spike') ... **Belvisia** (p. 26)
- b. Fronds dimorphic, coenosori on separate, narrowed fronds 11
- 11a. Clathrate scales present between the sporangia, rhizome filiform, to 1.1 mm thick, long-creeping **Lemmaphyllum** (p. 72)
- b. No clathrate scales present between the sporangia, rhizome usually thicker ... **Leptochilus** (p. 81)
- 12a. Sori stipitate on slender stalks on the lamina margin **Podosorus** (p. 143)
- b. Sori on the lamina surface, sometimes deeply sunken 13
- 13a. Sori marginal (*L. longifolius*) **Lepisorus** (p. 76)
- b. Sori costal to medial 14
- 14a. Young sori covered with peltate scales 15
- b. Young sori not covered with peltate scales 16
- 15a. Sori in a single row between midrib and margin, singly between each pair of the veins **Lepisorus** (p. 76)
- b. Sori in several irregular rows between midrib and margin (at least an irregular second row always present), 1–3 rows between each pair of veins **Microsorium** (p. 90)

- 16a. Rhizome c. 1 mm thick, filiform, sori in a single row between costa and margin **Lemmaphyllum** (p. 72)
- b. Rhizome over 1 mm thick, not filiform, rarely thinner, then sori in several rows between costa and margin **Microsorium** (p. 90)
- 17a. Lamina simple, trilobed, pinnatifid or pinnate, no articulation pad, abscission vein or nectaries present 18
- b. Lamina pinnatifid or pinnate, with either a distinct articulation, abscission vein between lobes or nectaries near the base of the lobes (or with all three) ... 20
- 18a. Lamina trilobed, fertile fronds with linear coenosori . **Christiopteris** (p. 34)
- b. Lamina simple or pinnate-pinnatifid, if trilobed then with separate sori ... 19
- 19a. Lamina with erect, scattered uniseriate hairs, sori irregularly scattered **Paraselliguea** (p. 131)
- b. Lamina glabrous or with very short, appressed glandular hairs, rarely with erect hairs, then sori in two rows between each pair of veins ... **Selliguea** (p. 175)
- 20a. Lamina pinnatifid or pinnate with conspicuous nectaries near the base of the pinnae; large plants, usually over 0.5 m high 21
- b. Pinnae without nectaries at the base, small plants less than 0.5 m high **Arthromeris** (p. 24)
- 21a. Separate, usually sterile, nest-forming base fronds present, distinctly shorter and less deeply dissected than the foliage fronds, apex of foliage fronds nearly always aborted (the insufficiently known *Aglaomorpha nectarifera*, should it be rediscovered, may also key out here) **Drynaria** (p. 36)
- b. Separate base fronds absent (sterile fronds, if present, large and deeply dissected), apical pinna normally developed **Aglaomorpha** (p. 10)

AGLAOMORPHA

(P. H. Hovenkamp & M. C. Roos)

- Aglaomorpha* Schott, Gen. Fil. (1836) ad t. 19; Hook. & Bauer, Gen. Fil. (1842) t. 91; Fée, Gen. Filic. (1850-1852) 266; J. Sm., Hist. Fil. (1875) 109; Alderw., Malayan Ferns Suppl. (1917) 418; Copel., Univ. Calif. Publ. Bot. 16 (1929) 116; Backer & Posth., Varenfl. Java (1939) 231; Ching, Sunyatsenia 5 (1940) 262; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 488; Copel., Gen. Fil. (1947) 201; Holttum, Revis. Fl. Malaya 2 (1954) 185; Copel., Fern Fl. Philipp. (1960) 493; De Vol in Fl. Taiwan 1 [Pterid.] (1975) 211; Pichi Serm., Webbia 31 (1977) 379; Roos, Drynarioideae (1985) 227; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 211. — *Polypodium* # *Pleopeltis* c. *Chrysopteris* *** *Aglaomorpha* Alderw., Malayan Ferns (1908) 671. — *Pleopeltis* # *Eupleopeltis* c. *Chrysopteris* *** *Aglaomorpha* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — Type species: *Aglaomorpha meyeniana* Schott.
- Psygmium* C. Presl, Tent. Pterid. (1836) 199. — *Aglaomorpha* # *Psygmium* Copel., Philipp. J. Sc., Bot. 6 (1911) 140; Univ. Calif. Publ. Bot. 16 (1929) 117. — Type species: *Psygmium elegans* C. Presl (= *Aglaomorpha meyeniana*).
- Dryostachyum* J. Sm., J. Bot. (Hook.) 3 (1841) 399; Hook. & Bauer, Gen. Fil. (1842) t. 95; Fée, Gen. Filic. (1850-1852) 275 ('*Dryostachyon*'); J. Sm., Hist. Fil. (1875) 108; Copel., Polypod. Philipp. (1905) 134; Alderw., Malayan Ferns Suppl. (1917) 417; Ching, Sunyatsenia 5 (1940) 261; Pichi Serm., Webbia 31 (1977) 417. — *Polypodium* # *Dryostachyum* H. Christ, Farnkr. Erde (1897) 121. — *Aglaomorpha* # *Dryostachyum* Copel., Philipp. J. Sc., Bot. 6 (1911) 140; 9 (1914) 8; Univ. Calif. Publ. Bot. 16 (1929) 117; Gen. Fil. (1947) 201; Fern Fl. Philipp. (1960) 493. — Type species: *Dryostachyum splendens* J. Sm. (= *Aglaomorpha splendens*).

- Photinopteris* J. Sm., J. Bot. (Hook.) 3 (1841) 403; Hook. & Bauer, Gen. Fil. (1842) t. 92; Fée, *Acrostichum* (1844-1845) 24, 102; C. Presl, Epim. Bot. (1849) 190; Fée, Gen. Filic. (1850-1852) 61; Bedd., Ferns Brit. India (1866) t. 211; Copel., Polypod. Philipp. (1905) 134; Philipp. J. Sc., Bot. 6 (1911) 140; Univ. Calif. Publ. Bot. 16 (1929) 122; Backer & Posth., Varenfl. Java (1939) 234; Ching, Sunyatsenia 5 (1940) 262; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 502; Holttum, Revis. Fl. Malaya 2 (1954) 187; Copel., Fern Fl. Philipp. (1960) 495; Pichi Serm., Webbia 31 (1977) 379. — *Lomariopsis* # *Drynaria* Mett., Fil. Hort. Bot. Lips. (1856) 22. — *Acrostichum* # *Photinopteris* Hook., Sp. Fil. 5 (1864) 281; Baker in Hook. & Baker, Syn. Fil. (1868) 434. — Type species: *Photinopteris horsfieldii* J. Sm. (= *Aglaomorpha acuminata*).
- Polypodium* # *Drynariopsis* Copel., Polypod. Philipp. (1905) 133; Philipp. J. Sc., Bot. 6 (1911) 140; Sarawak Mus. J. 2 (1917) 407. — *Polypodium* # *Pleopeltis* c. *Chrysopteris* *** *Drynariopsis* Alderw., Malayan Ferns (1908) 670. — *Pleopeltis* # *Eupleopeltis* c. *Chrysopteris* *** *Drynariopsis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Aglaomorpha* subg. *Drynariopsis* Copel., Univ. Calif. Publ. Bot. 16 (1929) 117. — *Drynariopsis* C. Chr. in Verdoorn, Manual Pterid. (1938) 548; Ching, Sunyatsenia 5 (1940) 262; Copel., Gen. Fil. (1947) 200; Fern Fl. Philipp. (1960) 492; Pichi Serm., Webbia 31 (1977) 379. — Type species: *Polypodium heracleum* Kunze (= *Aglaomorpha heraclea*).
- Thayeria* Copel., Philipp. J. Sc. 1, Suppl. (1906) 165; Philipp. J. Sc., Bot. 6 (1911) 140; 7 (1912) 41; Alderw., Malayan Ferns Suppl. (1917) 416; Copel., Univ. Calif. Publ. Bot. 16 (1929) 121; Gen. Fil. (1947) 202; Fern Fl. Philipp. (1960) 495; Pichi Serm., Webbia 31 (1977) 379. — *Drynaria* # *Thayeria* Alderw., Malayan Ferns (1908) 700. — Type species: *Thayeria cornucopia* Copel. (= *Aglaomorpha cornucopia*).
- Merinthosorus* Copel., Philipp. J. Sc., Bot. 6 (1911) 92; Univ. Calif. Publ. Bot. 16 (1929) 122; Ching, Sunyatsenia 5 (1940) 262; Copel., Gen. Fil. (1947) 202; Holttum, Revis. Fl. Malaya 2 (1954) 186; Pichi Serm., Webbia 31 (1977) 379. — Type species: *Merinthosorus drynarioides* (Hook.) Copel. (= *Aglaomorpha drynarioides*).
- Aglaomorpha* # *Hemistachyum* Copel., Philipp. J. Sc., Bot. 6 (1911) 140; Univ. Calif. Publ. Bot. 16 (1929) 117; Gen. Fil. (1947) 201. — *Hemistachyum* Ching, Sunyatsenia 5 (1940) 262. — Type species: *Aglaomorpha brooksii* Copel.
- Aglaomorpha* subg. *Holostachyum* Copel., Philipp. J. Sc., Bot. 9 (1914) 8; Univ. Calif. Publ. Bot. 16 (1929) 117. — *Holostachyum* Ching, Sunyatsenia 5 (1940) 262; Copel., Gen. Fil. (1947) 202; Pichi Serm., Webbia 31 (1977) 379. — Type species: *Aglaomorpha buchananii* Copel.
- Aglaomorpha* subg. *Pseudodrynaria* C. Chr., Index Filic. Suppl. 3 (1934) 13. — *Pseudodrynaria* C. Chr. in Verdoorn, Manual Pterid. (1938) 548; Ching, Sunyatsenia 5 (1940) 262; 6 (1941) 10; Copel., Gen. Fil. (1947) 201; De Vol in Fl. Taiwan I [Pterid.] (1975)*214, pl. 75; Pichi Serm., Webbia 31 (1977) 379. — Type species: *Aglaomorpha coronans* (Wall. ex Mett.) Copel.

Epiphytic, epilithic or terrestrial. *Rhizome* up to 5 cm thick, short- or long-creeping, internodes less than 10 to over 20 cm long, fronds usually not inserted on elevated phylloids, rarely on conspicuous phylloids. Anatomy: vascular bundles 20 to many (50–100), in cross section arranged in 1 or 2 flattened circles with conspicuous dorsal invaginations or protrusions; sclerenchyma strands absent. *Rhizome scales* appressed or spreading, pseudopeltate or rarely peltate, monomorphic, margin toothed. *Fronds* internally dimorphic, or monomorphic, sessile with a dilated base or stalked, frond bases imbricated or separate, forming individual nests, rachises not persistent, lamina pinnatifid or pinnate, with conspicuous nectaries situated below the junctions of rachis and costae, or of costae and veins, hairs sometimes present, spread over the lamina, or set in tufts on the abscission vein. Pinnae articulated to the rachis by an abscission vein, gradually smaller towards the frond-apex, entire, apical pinna present. *Venation* highly complex, with main areoles delimited by the veins and connecting veins, filled with numerous small areoles containing excurrent and recurrent free veinlets, each veinlet terminating in a hydathode. Fertile parts similar to sterile or usually narrowed.

Sori small, in rows along connecting veins or veinlets, or distinctly enlarged to soral patches, in one row between midrib and margin, sometimes forming a coenosorus. Sporangia glabrous or sometimes with 1–3 acicular hairs. Spores with spines or small globules. — **Fig. 1, 2.**

Distribution — Himalayas to Taiwan. Throughout *Malesia*, but absent from the Lesser Sunda Islands.

Taxonomy — The genus *Aglaomorpha* is used here in the wide sense proposed by Roos (1985). Other authors often segregate a number of small or monotypic genera, often based on the presence of a single character, many of which can hardly fail to be striking, considering the large size of most plants. Thus, a coenosorus has been used as a generic character for *Merinthosorus* and, in contrast, small sori as a character for *Drynariopsis*. A peculiar disposition of the fronds on the rhizome has served as character for *Thayeria*, absence of the peculiar frond base as character for *Holostachyum*. It is obvious, and admitted by most authors, that all these genera are closely related to *Aglaomorpha*. Accordingly, they are not distinguished here.

Aglaomorpha is the sister genus of *Drynaria*.

KEY TO THE SPECIES

- 1a. Fertile pinnae similar to sterile pinnae 2
- b. Fertile pinnae distinctly contracted 3
- 2a. Sori elliptic, in a single row between the veins, one in each main areole; rhizome scales without thickened midrib **4. A. coronans**
- b. Sori round, in many irregular rows between the veins, many in each main areole, rhizome scales with thickened midrib **6. A. heraclea**
- 3a. Fronds pinnate, pinnae shortly stalked, nectaries on small appendages at the pinna bases **1. A. acuminata**
- b. Fronds lobed to pinnatifid, pinnae sessile, nectaries on the lamina 4
- 4a. At least fertile fronds stalked, without dilated base, rhizome scales appressed .5
- b. All fronds sessile, with a dilated base, rhizome scales spreading or squarrose 9
- 5a. Sterile sessile fronds present **10. A. nectarifera** (once found, insufficiently known)
- b. Sterile fronds, if present, stalked 6
- 6a. Fertile fronds completely fertile, sori round, in several rows between costa and margin, rhizome scales peltate **12. A. parkinsoni**
- b. Fertile fronds at the base sterile, sori on narrowed apical parts, quadrangular or elongated, in a single row between costa and margin, rhizome scales pseudopeltate 7
- 7a. Sori mostly forming a continuous coenosorus, but rarely interrupted **7. A. hieronymi**
- b. Sori quadrangular or elongated, not a continuous coenosorus 8
- 8a. Sporangia glabrous **8. A. latipinna**
- b. Sporangia with 1–6 hairs **13. A. pilosa**
- 9a. Fertile pinnae between the sori distinctly contracted to a narrow inconspicuous wing 10
- b. Fertile pinnae not contracted between the sori 11

- 10a. Rhizome not fully covered by the scales, with conspicuous phyllopods, fronds more than 20 cm distant **3. *A. cornucopia***
- b. Rhizome completely covered with scales, phyllopods inconspicuous, fronds less than 10 cm apart **9. *A. meyeniana***
- 11a. Sori linear, coenosoroid, rhizome scales without thickened midrib **5. *A. drynarioides***
- b. Sori separate, rhizome scales with a thickened midrib 12
- 12a. Rhizome long-creeping, fronds over 20 cm distant, the midrib of rhizome scales black, sori round **11. *A. novoguineensis***
- b. Rhizome short-creeping, fronds less than 10 cm apart, midrib of rhizome scales brown 13
- 13a Sori in several rows, confluent into irregularly quadrangular patches, abscission vein glabrous **2. *A. brooksii***
- b. Sori forming a single row of regular, quadrangular, large patches, abscission vein with short hairs **14. *A. splendens***

1. *Aglaomorpha acuminata* (Willd.) Hovenkamp, *comb. nov.*

Acrostichum acuminatum Willd., Spec. Plant. ed. 5 (1810) 116, basionym, non *Acrostichum acuminatum* Poir. in Lam., Encycl. Méth. Suppl. 1 (1810) 120. — *Photinopteris humboldtii* C. Presl, Epim. Bot. (1851) 192. — *Photinopteris acuminata* (Willd.) Morton, Contr. U.S. Nat. Herb. 38 (1967) 31. — Type: *Herb. Willdenow 19539* (B), Philippines ('Peru, Martinica').

Aglaomorpha speciosa (Blume) Roos, Blumea 31 (1985) 153; Drynarioideae (1985) 244, nom. illeg. — *Lomaria speciosa* Blume, Enum. Pl. Javae (1828) 202. — *Photinopteris speciosa* C. Presl, Epim. Bot. (1851) 264; Diels in Engl. & Prantl, Nat. Pflanzenfam. I, 4 (1899) 328, f. 170d–f; Copel., Polypod. Philipp. (1905) 134; Univ. Calif. Publ. Bot. 16 (1929) 122; Backer & Posth., Varenfl. Java (1939) 235, f. 55; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 502; Copel., Gen. Fil. (1947) 203; Holttum, Revis. Fl. Malaya 2 (1955) 187; Copel., Fern Fl. Philipp. (1960) 496. — *Acrostichum rigidum* [Wall., Cat. (1829) n. 27, nom. nud.] Hook., Sp. Fil. 5 (1864) 281; Baker, Syn. Fil. (1868) 424, nom. illeg. — *Photinopteris rigida* Bedd., Ferns Brit. India (1866) t. 211; Handb. Ferns Brit. India (1883) 442, f. 269, nom. illeg. — *Dryostachyum speciosum* Kuhn in Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 296. — *Polypodium speciosum* H. Christ, Farnkr. Erde (1897) 121, nom. illeg., non Blume. — Type: *Blume s.n.* (L), Java.

[*Photinopteris simplex* J. Sm., J. Bot. (Hook.) 3 (1841) 403, nom. nud.; 4 (1842) 155. — Type: *Cuming 64* (BM holo; iso B, GH, K), Philippines, Luzon.]

Photinopteris horsfieldii [J. Sm., J. Bot. (Hook.) 3 (1841) 403, nom. nud.; 4 (1842) 155] Hook. & Bauer, Gen. Fil. (1842) 92. — *Lomariopsis horsfieldii* Mett., Fil. Hort. Bot. Lips. (1856) 22. — Types: *Horsfield s.n.* (K), Philippines, Luzon; *Cuming 362* (BM holo; iso B, GH, K, L, MICH, US, W), Philippines, Mindoro.

Photinopteris cumingii C. Presl, Epim. Bot. (1851) 192. — Type: *Cuming 362* p.p. (B, BM, GH, K, L, MICH, US, W), Philippines.

Rhizome 1–2 cm thick, glaucous, long-creeping, phyllopods 2–9 cm distant or more, not elevated; rachises not persistent. Anatomy: vascular bundles 15–30, c. 4 dorsal strands enlarged, arranged in 1 or 2 rows with dorsal protrusion, mostly with dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 3–7.5(–10) by 0.5–1.2 mm, index 5–10, basal auricles long, apex narrowly acuminate to filiform-subulate, dentate to ciliate, midrib absent. *Fronds* internally dimorphic, stalked, stipe to 10–35 cm long, with two rows of rudimentary pinnae, lamina pinnate, (30–)45–90 by 15–30 cm, index 2–4, glabrous to sparsely hairy with hairs up to 3 mm long, apical pinnae present,

nectaries on small extensions of the pinna-bases at the basiscopic, sometimes also at the acroscopic side. Sterile pinnae ovate, 7–30 by 3.5–10 cm, index 2–3.5, apex acuminate to caudate. Fertile pinnae in upper 2/3 of the frond, strongly narrowed, up to 10–27 by 0.4–0.7 cm. *Soral patches* linear (coenosori). Sporangia glabrous. Spores with small globules.

Distribution — Indochina to Malesia; in *Malesia*: Sumatra, Peninsular Malaysia, Java, Borneo, Philippines, Sulawesi.

Habitat — Epiphytic, spirally or vertically climbing, in primary and secondary forest, often epilithic on sand and limestone. In exposed or shaded positions up to 40 m above ground level. Altitude from sea level to 1600(–2300) m.

Notes — 1. The epithet *acuminata* was ignored by Roos (l.c.) in favour of the later *speciosa*, presumably on account of the homonymy between *Acrostichum acuminatum* Willd. and *A. acuminatum* Poir., both published in 1810. However, according to Fuchs [Taxon 11 (1962) 126] and Mortin (l.c.), Willdenow's name antedates Poirét's and should accordingly be adopted.

2. Juvenile fronds are more distinctly hairy than mature fronds, and generally with longer hairs.

2. *Aglaomorpha brooksii* Copel.

Aglaomorpha brooksii Copel., Philipp. J. Sc., Bot. 6 (1911) 141, t. 25; Alderw., Malayan Ferns Suppl. (1917) 418; Copel., Univ. Calif. Publ. Bot. 16 (1929) 117; Roos, Drynarioideae (1985) 230. — *Polypodium brooksii* C. Chr., Index Filic. Suppl. 1 (1913) 58. — *Hemistachyum brooksii* Ching, Sunyatsenia 5 (1940) 262. — Type: *Brooks* 39 (NY holo; iso BM), Borneo.

Rhizome 2–3 cm thick, short-creeping, phyllopoas up to 10 cm distant, not elevated; dilated frond bases imbricated, rachises not persistent. Anatomy: vascular bundles many, equally sized, arranged in two rows, with invaginations, these sometimes forming a closed circle, with dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 7–26 by 1.2–3 mm, index 5–10, basal auricles short, apex narrowly acuminate to long filiform, dentate, midrib present. *Fronds* internally dimorphic, sessile, the dilated base lobed, upwards pinnatifid, 80–110 by 25–50 cm or longer, index c. 3, glabrous or with short acicular hairs set in tufts on the abscission vein, apical pinna present. Sterile pinnae sometimes with a basal constriction, 16–30 by 2.5–5.5 cm, index 4.5–6.5, margin entire, apex acute to acuminate. Fertile pinnae in upper 2/3 of the frond, distinctly narrowed, up to 10–18 by 1–2 cm, index (6–)10–16. *Soral patches* in 1–3 rows between midrib and margin, irregularly shaped, often confluent into irregularly quadrangular patches, 3–6 by 2–5 mm. Sporangia glabrous. Spores without spines, small globules present. — **Fig. 1e.**

Distribution — *Malesia*: Borneo, restricted to the northern part.

Habitat — Epiphytic, forming a ring-shaped basket around tree-trunks; in primary forest. Altitude 1000–1800 m.

3. *Aglaomorpha cornucopia* (Copel.) Roos

Aglaomorpha cornucopia (Copel.) Roos, Blumea 31 (1985) 153; Drynarioideae (1985) 235. — *Thayeria cornucopia* Copel., Philipp. J. Sc. 1, Suppl. (1906) 165, t. 28; Philipp. J. Sc., Bot. 6 (1911) 140; 7 (1912) 41, t. 1; Alderw., Malayan Ferns Suppl. (1917) 416; Copel., Univ. Calif.

Publ. Bot. 16 (1929) 121; Gen. Fil. (1947) 202; Fern Fl. Philipp. (1960) 495; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 161. — *Drynaria cornucopia* Alderw., Bull. Dép. Agric. Indes Néerl. 21 (1908) 8; Malayan Ferns (1908) 700. — Type: *Copeland* 1770 (NY; iso B, S), Philippines, Mindanao.

Rhizome 1–3 cm thick, phylloids conspicuous, but not all bearing fronds, c. 3 cm distant; dilated frond bases separate, forming individual nests, rachises not persistent. Anatomy: vascular bundles 20–many, equally sized, arranged in one row with a dorsal protrusion, or with conspicuous dorsal invaginations, without dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 2–5 by 1–3 mm, index 1.5–3, basal auricles short or long, margin entire, apex rounded to acute, midrib present. *Fronds* internally dimorphic, sessile, the dilated base lobed, upwards pinnatifid, 50–80 by 25–30 cm, index 2–3, glabrous or abscission vein with tufts of very short acicular hairs, apical pinnae present. Sterile pinnae without basal constriction, 7–15 by 2–2.5 cm, index 3.5–6, apex acute to obtuse. Fertile pinnae in upper 2/3 of the frond, distinctly narrowed, up to 10–18 by 0.5–1 cm, linear, contracted between the sori. *Soral patches* in one row between midrib and margin, protruding bead-like, round or slightly elongated, 2–3 mm wide. Sporangia glabrous. Spores with spines.

Distribution — *Malesia*: Philippines (Luzon, Mindanao).

Habitat — Epiphytic, spirally climbing, sometimes epilithic; in primary forest and open vegetation. Altitude 1100–2200 m.

4. *Aglaomorpha coronans* (Mett.) Copel.

Aglaomorpha coronans (Wall. ex Mett.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 117; Tagawa, Acta Phytotax. Geobot. 8 (1939) 234; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 488, f. 57: 3, 4; Roos, Drynarioideae (1985) 236. — *Polypodium coronans* [Wall., Cat. (1829) n. 288, nom. nud.] Mett., Farngett. I. Polypodium (1856) 121, t. 3, f. 40, 41; Hook., Fil. Exot. (1859) pl. 91; Hook., Sp. Fil. 5 (1864) 95; Copel., Philipp. J. Sc., Bot. 6 (1911) 140. — [*Phymatodes coronans* C. Presl, Tent. Pterid. (1836) 198, nom. nud.] — *Drynaria coronans* [J. Sm., J. Bot. (Hook.) 3 (1841) 399, nom. nud.] T. Moore, Index Filic. II (1862) 345, pl. 63A; Bedd., Ferns Brit. India (1865) t. 13; J. Sm., Hist. Fil. (1878) 108; Bedd., Handb. Ferns Brit. India (1883) 338, f. 187. — *Pseudodrynaria coronans* Ching, Sunyatsenia 5 (1940) 262; 6 (1941) 10; Copel., Gen. Fil. (1947) 201. — *Pleopeltis coronans* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — Type: *Wallich* 288 (B; iso BM, BR, G, GH, K, L, P, US, W), Nepal.

Polypodium conjugatum Baker in Hook. & Baker, Syn. Fil. (1868) 366, non Poir. (1804), nom. illeg.; nec Kaulf. (1827), nom. illeg. — *Drynaria conjugata* Baker ex Bedd., Suppl. Ferns S. India & Brit. India (1876) 23. — Type: not traced.

Rhizome 2–3 cm thick or more, short-creeping, phylloids up to 10 cm distant, not elevated; dilated frond bases imbricated, rachises not persistent. Anatomy: vascular bundles many, equally sized, arranged in 1 or 2 rows, the conspicuous dorsal invaginations sometimes forming fully closed circles, without dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 5–20 by 0.5–1 mm, index (6–)10–25, basal auricles short, the margin toothed, apex narrowly acuminate to short-filiform, midrib absent. *Fronds* monomorphic or with the fertile parts slightly narrowed, sessile, the dilated base lobed, upwards pinnatifid up to 0.2 cm from the rachis, 70–170 by 20–45 cm, index 3–6, glabrous, apical pinna present. Pinnae without basal constriction, 15–35 by 1.5–5 cm, index 5–7(–10), margin entire, apex acute to acuminate. *Sori* usually present on all pinnae, in several rows between midrib and margin, one in each main areole,

elongated, 1–3 mm in largest diameter, slightly sunken. Sporangia glabrous. Spores with spines. — **Fig. 1h.**

Distribution — Eastern Himalayas to Taiwan and Ryukyu Islands, Indochina. In *Malesia*: Peninsular Malaysia.

Habitat — Epiphytic, forming a ring shaped-basket around tree-trunks, often epilithic; primary and secondary forest, sometimes in more open vegetation, usually in shade, at 0–25 m above ground level.

Note — The dilated frond base is sometimes poorly developed and no more than a wing on the stipe.

5. *Aglaomorpha drynarioides* (Hook.) Roos

Aglaomorpha drynarioides (Hook.) Roos, *Blumea* 31 (1985) 153; *Drynarioideae* (1985) 242. — *Acrostichum drynarioides* Hook., *Sp. Fil.* 5 (1864) 284; Baker, *Syn. Fil.* (1868) 425. — *Photinopteris drynarioides* Bedd., *Ferns Brit. India* (1869) t. 325; *Handb. Ferns Brit. India* (1883) 442, f. 270. — *Dryostachyum drynarioides* Kuhn in *Miq., Ann. Mus. Bot. Lugd.-Bat.* 4 (1869) 296. — *Polypodium drynarioides* H. Christ, *Farnkr. Erde* (1897) 117, nom. illeg., non Griseb. — *Merinthosorus drynarioides* Copel., *Philipp. J. Sc., Bot.* 6 (1911) 92; *Univ. Calif. Publ. Bot.* 16 (1929) 122; *Gen. Fil.* (1947) 202; *Holtttum, Revis. Fl. Malaya* 2 (1954) 186. — Type: *Norris s.n.* (K; iso B), Malayan Peninsula, Penang.

Acrostichum thomsoni Baker, *J. Linn. Soc. Bot.* 15 (1876) 111; Hook. *Icon. Pl. ser. 3* (1887) pl. 1694. — *Dryostachyum thomsoni* Diels in *Engl. & Prantl, Nat. Pflanzenfam.* I, 4 (1899) 328. — *Merinthosorus thomsonii* Copel., *Univ. Calif. Publ. Bot.* 18 (1942) 226. — Type: *Moseley s.n.* (K), Admiralty Islands.

Dryostachyum singulare Mett. in *Miq., Ann. Mus. Bot. Lugd.-Bat.* 4 (1869) 296, nom. illeg. — Type: *Korthals* (?) (L), Sumatra.

Rhizome 2–3 cm thick or more, densely covered with scales, not glaucous, short-creeping, phylloids up 10 cm distant, not elevated; dilated frond bases imbricated, rachises not persistent. Anatomy: vascular bundles many, equally sized, arranged in one row with a conspicuous dorsal invagination, without dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 10–21(–27) by 0.7–1.5 mm, index 8–20, basal auricles short, apex narrowly acuminate to long-filiform, strongly dentate with recurved teeth, midrib absent. *Fronde*s internally dimorphic, sessile, the dilated base lobed, sometimes narrowed, upwards pinnatifid, 50–175 by 15–45 cm, index 3–3.5, glabrous to sparsely set with short acicular hairs, apical pinnae present. Sterile pinnae with or without basal constriction, 9–26 by 2–5.5 cm, index 3.5–6.5, margin entire, apex acute to acuminate. Fertile pinnae in upper 2/3 of the frond, strongly narrowed, up to 10–45 by 0.3–0.5 cm, completely covered with longitudinal coenosori. *Coenosorus* linear, sometimes interrupted, very shallowly sunken. Sporangia glabrous. Spores with small globules.

Distribution — Malesia to Pacific. In *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Moluccas, New Guinea; New Britain, New Ireland, Solomon Is.

Habitat — Epiphytic, forming a ring-shaped basket around tree trunks, sometimes epilithic or terrestrial; primary and secondary forest, open vegetations and several types of plantations (coconut, coffee, cocoa, rubber). Usually in more or less exposed places, at 5–30 m above ground level. Altitude from sea level to 1800 m.

Note — The circular baskets occasionally provide a sleeping nest for opossums.

6. *Aglaomorpha heraclea* (Kunze) Copel.

Aglaomorpha heraclea (Kunze) Copel., Univ. Calif. Publ. Bot. 16 (1929) 117; Backer & Posth., Varenfl. Java (1939) 232; Holttum, Revis. Fl. Malaya 2 (1954) 185; Dansk Bot. Ark. 20 (1961) 21; Roos, Drynarioideae (1985) 238. — *Polypodium heracleum* Kunze, Bot. Zeitung (Berlin) 6, 7 (1848) 117; Mett., Farngatt. I. Polypodium (1856) 117, t. 3, 52; Hook., Gard. Ferns (1862) pl. 1; Sp. Fil. 5 (1864) 93; Baker, Syn. Fil. (1868) 366; Racib., Pterid. Buitenzorg (1898) 116; Copel., Polypod. Philipp. (1905) 133; Philipp. J. Sc., Bot. 6 (1911) 140; Sarawak Mus. J. 2 (1917) 407; Brause, Bot. Jahrb. Syst. 56 (1920) 204. — *Drynaria heraclea* T. Moore, Index Filic. II (1862) 346; J. Sm., Ferns Brit. & For. (1866) 103; Hist. Fil. (1875) 108. — *Pleopeltis heraclea* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Drynariopsis heraclea* Ching, Sunyatsenia 5 (1940) 262; Copel., Gen. Fil. (1947) 201; Holttum, Revis. Fl. Malaya 2 (1954) 185; Copel., Fern Fl. Philipp. (1960) 492. — Type: *Zollinger 977* (B, n.v.), Java.

Rhizome 2–3 cm thick or more, short-creeping, phyllopods up to 10 cm distant, not elevated; dilated frond bases imbricated, rachises not persistent. Anatomy: vascular bundles many, equally sized, arranged in 1 or 2 rows with conspicuous invaginations sometimes forming an enclosed circle, with or without dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 7–40 by (0.6–)1–2.5 mm, index 6–25(–35), basal auricles short, apex long-filiform, dentate to strongly dentate, ill-defined midrib present. *Fronde*s monomorphic, sessile, the dilated base lobed, upwards pinnatifid, (60–)100–200(–350) by 20–65(–100) cm, index 3–7, glabrous or with very short hairs scattered over the lamina, apical pinnae present. Pinnae without basal constriction, 15–65 by 3–14 cm, index 4–8, margin entire, apex acute to acuminate. *Sori* usually present on all pinnae, in many rows between midrib and margin, many in each main areole, in two irregular rows parallel to the connecting veins, round, up to 2 mm wide, slightly sunken (often distinctly pustulate on the upper surface). Sporangia glabrous. Spores with small globules. — **Fig. 1i.**

Distribution — Throughout *Malesia* to the Solomon Islands.

Habitat — Epiphytic, forming a ring-shaped basket around tree trunks, rarely epilithic; primary and secondary forest, in shady localitiess, up to 25 m from ground level, rarely higher, occasional forming terrestrial rosettes. Altitude from sea level to 1700 m.

7. *Aglaomorpha hieronymi* (Brause) Copel.

Aglaomorpha hieronymi (Brause) Copel., Philipp. J. Sc., Bot. 9 (1914) 9; Univ. Calif. Publ. Bot. 16 (1929) 417; Roos, Drynarioideae (1985) 249. — *Dryostachyum hieronymi* Brause, Bot. Jahrb. Syst. 49 (1912) 55; Alderw., Malayan Ferns Suppl. (1917) 417; Copel., Univ. Calif. Publ. Bot. 18 (1942) 226; Gen. Fil. (1947) 203. — Type: *Schlechter 17850* (B), New Guinea. *Merinthosorus hieronymi* Copel., Univ. Calif. Publ. Bot. 18 (1942) 226; Gen. Fil. (1947) 203. — Type: *Brass 11700* (NY; iso GH, L, BM), New Guinea.

Rhizome 1–2 cm thick, long-creeping, phyllopods 20 cm or more distant, not elevated; rachises not persistent. Anatomy: vascular bundles 10–20, c. 4 enlarged dorsal strands, arranged in one row with a dorsal protrusion, with dark bundle sheaths. *Rhizome scales* appressed, pseudopeltate, 2.5–7.5 by 0.8–1.6 mm, index 2.5–7, basal auricles long, margin with curly cilia, the apex acute to short-filiform, midrib absent. *Fronde*s internally dimorphic, stalked, stipe to 8–25(–35) cm long, inconspicuously winged, wing lobed (sinusoid), lamina pinnatifid to within 2 mm from the costa, 40–

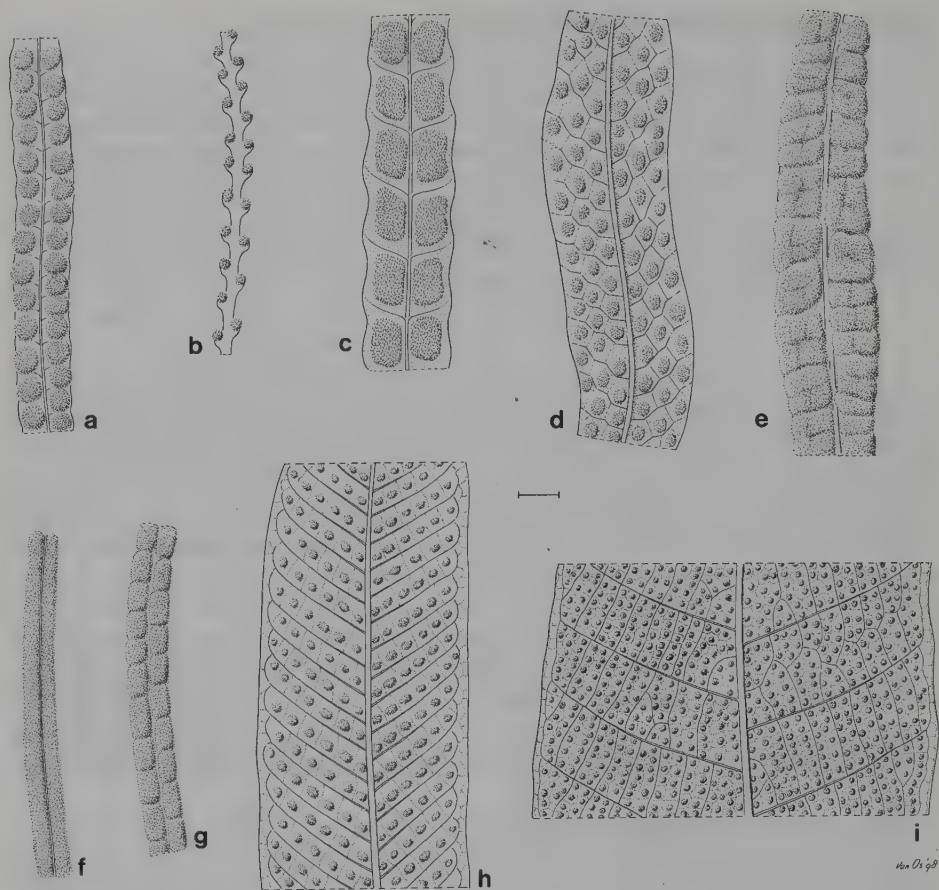


Fig. 1. Fertile parts in *Aglaomorpha* species. — a. *A. novoguineensis* (Brause) C. Chr. (Wheeler ANU 5695A). — b. *A. meyeniana* Schott (Ramos BS 13626). — c. *A. splendens* (Hook. & Bauer) Copel. (Price 1182). — d. *A. parkinsonii* (Baker) Parris & Roos (NGF 39116). — e. *A. brooksii* Copel. (Nooteboom & Chai 1885). — f. *A. hieronymi* (Brause) Copel. (Brass 11700). — g. *A. latipinna* (C. Chr.) Roos (Posthumus 2470). — h. *A. coronans* (Mett.) Copel. (van Beusekom & Phengklai 847). — i. *A. heraclea* (Kunze) Copel. (Worthington 12958). — Scale bar = 1 cm. Drawings by J.H. van Os.

95 by 12–25 cm, index 2–5, with scattered hairs to 2 mm long on rachis and veins, apical pinna present. Sterile pinnae without basal constriction, 6–16 by 1–3 cm, index 4–8, apex acuminate to caudate. Fertile pinnae in upper part of the frond, strongly narrowed, up to 10–27 by 0.3–1 cm, linear. *Soral patches* in one row between midrib and margin, elongated, 3–4 mm long or longer, forming linear coenosori to 2 mm wide, sunken. Sporangia with 1–3 short acicular hairs. Spores with small globules. — Fig. 1f.

Distribution — *Malesia*: New Guinea.

Habitat — Epiphytic, spirally or vertically climbing, sometimes terrestrial; primary and secondary forest, up to 15 m above ground level. Also epilithic on limestone. Altitude 1000–1800 m.

Note — *Aglaomorpha hieronymi* is very similar to *A. pilosa*, and intermediate specimens may be found (e.g., Walker T 9162).

8. *Aglaomorpha latipinna* (C. Chr.) Roos

Aglaomorpha latipinna (C. Chr.) Roos, Blumea 31 (1985) 153; Drynarioideae (1985). — *Holostachyum hieronymi* var. *latipinna* C. Chr., Svensk Bot. Tids. 16 (1922) 96. — Type: Kaudern 52 (S), Celebes.

Rhizome 1–2 cm thick, long-creeping, phylloids 8–10 cm distant, not elevated; rachises not persistent. Anatomy: vascular bundles 15–30, c. 4 dorsal strands enlarged, arranged in 1 or 2 rows with dorsal protrusion, with or without dark bundle sheaths. *Rhizome scales* appressed, pseudopeltate, 4–8 by 0.8–1.8 mm, index 3–7, basal auricles long, margin with curly cilia, apex narrowly acuminate to short-filiform, midrib indistinct or absent. *Fronds* internally dimorphic, stalked, stipe 10–35 cm long, inconspicuously winged near base, wing lobed near the lamina (sinusoid), lamina pinatifid to within 2 mm from costa, 40–80 by 15–28 cm, index 2.5–4, with scattered acicular hairs up to 1.5 mm long, apical pinna present. Sterile pinnae with or without basal constriction, 8–16 by 1.5–4.3 cm, index 4–8, margin entire, apex acuminate to caudate. Fertile pinnae in upper part of the frond, distinctly narrowed, up to 12–26 by 0.6–1 cm, linear. *Soral patches* in one row between midrib and margin, elongate, 3–4 mm wide or more, very shallowly sunken. Sporangia glabrous. Spores with small globules. — **Fig. 1g.**

Distribution — *Malesia*: Sulawesi.

Habitat — Epiphytic, spirally or vertically climbing or epilithic; primary and secondary forest. Altitude 1000–1350 m.

9. *Aglaomorpha meyeniana* Schott

Aglaomorpha meyeniana Schott, Gen. Fil. (1836) ad t. 19; Hook. & Bauer, Gen. Fil. (1842) t. 91; Fée, Gen. Filic. (1850–1852) 266; J. Sm., Hist. Fil. (1878) 110; Copel., Philipp. J. Sc., Bot. 6 (1911) 141; Alderw., Malayan Ferns Suppl. (1917) 418; Copel., Univ. Calif. Publ. Bot. 16 (1929) 117; Fern Fl. Philipp. (1960) 494; De Vol in Fl. Taiwan 1 [Pterid.] (1975) 211, pl. 73; Roos, Drynarioideae (1985) 240. — *Polypodium meyenianum* Hook., Sp. Fil. 5 (1864) 94; Baker in Hook. & Baker, Syn. Fil. (1868) 366; Copel., Polypod. Philipp. (1905) 133. — *Pleopeltis meyeniana* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Dryostachyum meyeniana* Brause, Bot. Jahrb. Syst. 49 (1912) 57. — Type: *Cuming 49* (B, BM, K, L), Philippines, Luzon. *Psygium elegans* C. Presl, Tent. Pterid. (1836) 199. — Type: *Meyen herb s.n.*, (PRC, n.v.; iso B), Philippines, Luzon.

Rhizome 2–3 cm thick or more, short-creeping, phylloids up to 10 cm distant, not elevated; dilated frond bases imbricated, rachises not persistent. Anatomy: vascular bundles many, equally sized, arranged in 1 or 2 rows with conspicuous dorsal invaginations, without dark bundle sheaths. *Rhizome scales* spreading, pseudopeltate, 6–15 by 0.4–1 (–1.3) mm, index 12–20, basal auricles short, apex narrowly acuminate to long-filiform, strongly dentate, midrib absent. *Fronds* internally dimorphic, sessile,

the dilated base lobed, upwards pinnatifid, 35–105 by 15–30 cm, index 2.5–4.5(–5.5), glabrous or abscission vein with tufts of very short acicular hairs, apical pinna present. Sterile pinnae without basal constriction, 7.5–15 by 1.5–3.5 cm, index (2.5–)4–6(–7), apex rounded, acute to acuminate. Fully fertile pinnae in upper 2/3 of the frond, distinctly narrowed, up to 5–20 by 0.4–0.8 cm, contracted between the sori. *Soral patches* in one row along the pinna-midrib, protruding bead-like, round, 1–3 mm wide. Sporangia glabrous. Spores with spines. — **Fig. 1b.**

Distribution — Taiwan; in *Malesia*: Philippines (Luzon, Mindoro, Catanduanes, Cebu).

Habitat — Epiphytic, forming a ring-shaped basket around tree trunks, sometimes epilithic or terrestrial; primary forest, usually in exposed situations. Altitude 450–800(–1600) m.

10. *Aglaomorpha nectarifera* (Baker) Roos

Aglaomorpha nectarifera (Baker) Roos, Blumea 31 (1985) 153; Drynarioideae (1985) 252. — *Polypodium nectariferum* Baker in Becc., Malesia 2 (1886) 247, t. 65. — *Drynaria nectarifera* Diels in Engl. & Prantl, Nat. Pflanzenfam. I, 4 (1899) 330; Alderw., Malayan Ferns (1908) 700; Brause, Bot. Jahrb. Syst. 56 (1920) 207. — *Thayeria nectarifera* Copel., Philipp. J. Sc. 1, Suppl. (1906) 165; Philipp. J. Sc., Bot. 6 (1911) 140; 7 (1912) 41; Alderw., Malayan Ferns Suppl. (1917) 416; Copel., Univ. Calif. Publ. Bot. 16 (1929) 121; Gen. Fil. (1947) 202. — Type: *Beccari s.n.*, Oct. 1882 (FI; iso K), New Guinea.

Rhizome with conspicuous phylloids. *Rhizome scales* appressed, peltate, round, margin dentate. *Fronds* dimorphic. Sterile fronds sessile, with dilated base, lobed, the lobes with rounded apex. Fertile fronds internally dimorphic, stalked, lamina pinnatifid, sterile pinnae with basal constriction, entire, apex acute, apical pinna present; fertile frond parts in upper 2/3 of the lamina, distinctly narrowed, pinnae linear. *Soral patches* round, in one row between midrib and margin, protruding bead-like.

Distribution — *Malesia*: New Guinea (Irian Jaya: Arfak Mts).

Habitat — No data available.

Note — Known from only a single, incomplete collection.

11. *Aglaomorpha novoguineensis* (Brause) C. Chr.

Aglaomorpha novoguineensis (Brause) C. Chr., Index Filic. Suppl. 2 (1917) 3; Copel., Univ. Calif. Publ. Bot. 16 (1929) 117; Roos, Drynarioideae (1985) 233. — *Dryostachyum novoguineense* Brause, Bot. Jahrb. Syst. 49 (1912) 56, f. 3D; Alderw., Malayan Ferns Suppl. (1917) 417. — Type: *Schlechter 18266* (B), New Guinea.

Dryostachyum novoguineense Brause var. *lanceolata* Brause, Bot. Jahrb. Syst. 56 (1922) 207. — Type: *Ledermann 13020* (B), New Guinea.

Rhizome 1–3 cm thick, long-creeping, phylloids 20 cm distant or more, not elevated; dilated frond bases separate, forming individual nests, rachises not or rarely persistent. Anatomy: vascular bundles 20–many, c. 4 dorsal strands enlarged, arranged in 1 or 2 rows with dorsal protrusions or invaginations, without dark bundle sheaths. *Rhizome scales* appressed to spreading, pseudopeltate, 5–20 by 0.5–1.5 mm, index 4–10(–20), basal auricles short to long, margin clathrate, dentate, apex narrowly acuminate to shortly filiform, midrib present, well-defined, sharply set off from the clath-

rate margin. *Fronds* internally dimorphic, sessile, the dilated base lobed, upwards pinnatifid, 70–110 by 30–40 cm, index 2.5–3, short acicular hairs set in tufts on the abscission vein, sometimes also on the lower surface of the rachis, apical pinna present. Sterile pinnae without basal constriction, 15–25 by 2.5–4 cm, index 5.5–6.5, apex acute to acuminate. Fertile pinnae in upper 2/3 of the frond, distinctly narrowed, up to 10–20 by 0.7–1.4 cm, index 15 or linear. *Soral patches* in one row between midrib and margin, round, 2–4 mm wide. Sporangia glabrous. Spores with small globules. — **Fig. 1a.**

Distribution — *Malesia*: New Guinea.

Habitat — Epiphytic, spirally climbing, rarely epilithic or terrestrial; in forest, growing up to 20 m above ground level. Altitude 1100–1800(–2300) m.

12. *Aglaomorpha parkinsoni* (Baker) Parris & Roos

Aglaomorpha parkinsoni (Baker) Parris & Roos, *Blumea* 31 (1985) 153; Roos, *Drynarioideae* (1985). — *Polypodium parkinsoni* Baker, *Ann. Bot. (London)* 5 (1891) 480. — *Drynaria parkinsoni* Diels in Engl. & Prantl, *Nat. Pflanzenfam. I*, 4 (1899) 143; Brause, *Bot. Jahrb. Syst.* 56 (1920) 207. — Type: *Parkinson* (*Herb. Mueller 377*) (K), New Britain.

Polypodium ludovicianum Baker, *Ann. Bot. (London)* 8 (1894) 131. — Type: *MacGregor* (*Herb. Mueller 100 & 104*) (K), Louisiades.

Polypodium schlechteri Brause, *Bot. Jahrb. Syst.* 49 (1912) 54, f. 3C, nom. illeg., non Alderw. (1909). — *Aglaomorpha schlechteri* Copel., *Philipp. J. Sc., Bot.* 9 (1914) 9; *Univ. Calif. Publ. Bot.* 16 (1929) 117. — *Pleopeltis schlechteri* Alderw., *Malayan Ferns Suppl.* (1917) 395. — *Polypodium ledermannii* Brause, *Bot. Jahrb. Syst.* 56 (1920) 202. — *Aglaomorpha ledermannii* Brause ex C. Chr., *Index Filic. Suppl.* 3 (1934) 20, nom. illeg. — *Dryostachyum ledermannii* Copel., *Gen. Fil.* (1947) 202, nom. illeg. — Type: *Schlechter 16614* (B; iso US, K), New Guinea. *Dryostachyum mollepilosum* Rech., *Denkschr. Akad. Wiss. Wien* 89 (1913) 480. — Type: *Rehinger 4443* (W), Bougainville.

Aglaomorpha buchananii Copel., *Philipp. J. Sc., Bot.* 9 (1914) 8; *Univ. Calif. Publ. Bot.* 16 (1929) 117. — *Pleopeltis buchananii* Alderw., *Malayan Ferns Suppl.* (1917) 396. — *Holostachyum buchananii* Ching, *Sunyatsenia* 5 (1940) 262; Copel., *Gen. Fil.* (1947) 202. — Type: *King 412* (NY; iso MICH, NSW), New Guinea

Drynaria amphilogos Alderw., *Nova Guinea* 14 (1924) 16. — Type: *Lam 700* (L), New Guinea.

Rhizome 1–2 cm thick, long-creeping, phyllopods over 20 cm distant, not elevated; rachises not persistent. Anatomy: vascular bundles 10–20, c. 4 dorsal strands enlarged, arranged in one row with a dorsal protrusion, with dark bundle sheaths. *Rhizome scales* appressed to spreading, peltate, 3–7 by 0.5–2.5 mm, index 2.5–7, margin entire near base, upwards dentate with short and long teeth, apex acute, occasionally acuminate, with curly cilia, midrib absent. *Fronds* dimorphic. Sterile fronds stalked, stipe to 17 cm long, inconspicuously winged, wing lobed (sinusoid), lamina pinnatifid to 0.2–0.5 cm from costa, 25–65 by 12–25 cm, index 1.5–3, with hairs to 0.5 mm long on the lamina, on midrib and costae to 2 mm long; apical pinnae present. Sterile pinnae with or without basal constriction, 7–15 by 2.5–4 cm, index 2–4, margin entire, apex rounded, acute to acuminate. Fertile fronds narrowed, long-stalked, stipe to 13–35 cm, lamina 17.5–45 by 10–20(–25) cm, otherwise similar to sterile fronds. *Sori* in several rows between midrib and margin, one in each areole, round or sometimes elongated, occasionally confluent to a transverse coenosorus, very shallowly sunken. Sporangia with 1–3 acicular hairs. Spores with small globules. — **Fig. 1d.**

Distribution — East Malesia to the Pacific. In *Malesia*: Moluccas, New Guinea, Manus I., New Britain, New Ireland.

Habitat — Epiphytic, spirally or vertically climbing, often epilithic or terrestrial; primary and secondary forest, growing up to 30 m above ground level, also epilithic on limestone or granite. Altitude from sea level to 1600 m.

Note — The nectaries in the sinuses of the pinnae are very conspicuous in fresh specimens of this species, less so in dry material.

13. *Aglaomorpha pilosa* (Hook. & Bauer) Copel.

Aglaomorpha pilosa (J. Sm. ex Hook. & Bauer) Copel., Philipp. J. Sc., Bot. 6 (1911) 141; Univ. Calif. Publ. Bot. 16 (1929) 117; Gen. Fil. (1947) 202; Fern Fl. Philipp. (1960) 493; Roos, Drynarioideae (1985) 247; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 146. — *Dryostachyum pilosum* [J. Sm., J. Bot. (Hook.) 3 (1841) 399, nom. nud.] Hook. & Bauer, Gen. Fil. (1842) t. 95; Fée, Gen. Filic. (1850-1852) 275; J. Sm., Hist. Fil. (1875) 109; Copel., Philipp. J. Sc. 1, Suppl. (1906) 165; Brause, Bot. Jahrb. Syst. 49 (1912) 55. — *Polypodium splendens* var. *pilosum* Hook., Sp. Fil. 5 (1864) 96. — *Polypodium pilosum* Salomon, Nomenclator (1883) 314. — *Dryostachyum splendens* var. *pilosum* C. Chr., Index Filic. (1906) 301; Alderw., Malayan Ferns (1908) 701. — Type: *Cuming 90* (BM; iso B, F, GH, K, L, NY, US, W), Philippines, Luzon.

Rhizome 1–2 cm thick, long-creeping, phyllopoas over 20 cm distant, not elevated; rachises not persistent. Anatomy: vascular bundles 15–20, c. 4 dorsal strands enlarged, arranged in 1 or 2 rows with a dorsal protrusion, with dark bundle sheaths. *Rhizome scales* appressed, pseudopeltate, 3–7 by 0.8–2.5 mm, index 2.5–5, basal auricles long, margin with curly cilia, apex acute to acuminate, midrib absent. *Fronas* internally dimorphic, stalked, stipe 3–16(–30) cm long, inconspicuously winged near base, wing lobed near lamina (sinusoid), lamina pinnatifid to less than 0.2 mm from costa, 25–75 by 8–30 cm, index 3.5–6, with hairs up to 1.5 mm long on rachis and veins, apical pinna present. Sterile pinnae without basal constriction, 5–16 by 1–3.5 cm, index 3.5–6, margin entire, apex acuminate to caudate. Fertile pinnae in upper part of the frond, distinctly narrowed, up to 4–14 by 0.4–1.5 cm, index 6.5 to linear. *Soral patches* in one row between midrib and margin, elliptic to elongate, 3–5 by 2–4 mm, shallowly sunken. Sporangia with 1–6 acicular hairs. Spores with small globules.

Distribution — In *Malesia*: Philippines (Luzon, Negros, Mindanao), Moluccas (Seram).

Habitat — Epiphytic, spirally or vertically climbing, sometimes terrestrial; high epiphyte in crowns of trees (Zamora & Co l.c.). Altitude 200–700 m.

14. *Aglaomorpha splendens* (Hook. & Bauer) Copel.,

Aglaomorpha splendens (J. Sm. ex Hook. & Bauer) Copel., Philipp. J. Sc., Bot. 6 (1911) 141; Alderw., Malayan Ferns Suppl. (1917) 417; Copel., Univ. Calif. Publ. Bot. 16 (1929) 117; Gen. Fil. (1947) 202; Fern Fl. Philipp. (1960) 494; Roos, Drynarioideae (1985) 232. — *Dryostachyum splendens* [J. Sm., J. Bot. (Hook.) 3 (1841) 399, nom. nud.] Hook. & Bauer, Gen. Fil. (1842) t. 95; Fée, Gen. Filic. (1850-1852) 275; J. Sm., Hist. Fil. (1875) 109; Copel., Polypod. Philipp. (1905) 134; Philipp. J. Sc. 1, Suppl. (1906) 165, pl. 26, 27; Alderw., Malayan Ferns (1908) 701; Rosenst., Nova Guinea 8 (1912) 729; Alderw., Malayan Ferns Suppl. (1917) 417. — *Polypodium splendens* Hook., Sp. Fil. 5 (1864) 95, nom. illeg. (non p. 52); Baker in Hook.

& Baker, Syn. Fil. (1868) 367. — *Drynaria splendens* Bedd., Ferns Brit. India (1869) t. 316; Suppl. Ferns S. India & Brit. India (1876) 23; Handb. Ferns Brit. India (1883) 339, f. 188. — Type: *Cuming* 87 (BM; iso B, GH, K, L, NY, S, US, W), Philippines, Luzon.

Rhizome 2–3 cm thick, short-creeping, phyllopoas up to 10 cm distant, not elevated; dilated frond bases imbricated, rachises not persistent. Anatomy: vascular bundles many, equally sized, arranged in one row with a dorsal invagination, dark bundle sheaths weakly developed or absent. *Rhizome scales* spreading, pseudopeltate, (7–) 10–22 by 1–3 mm, index 6–13, basal auricles short, apex narrowly acuminate to long-filiform, dentate, midrib present. *Fronds* internally dimorphic, sessile, the dilated base lobed, upwards pinnatifid, 75–200 by 25–50 cm, index 2.5–4, glabrous or with short acicular hairs spread over the lamina, apical pinna present. Sterile pinnae without basal constriction, 10–35 by 3–6.5 cm, index 4–6.5, margin entire, apex acute to acuminate. Fertile pinnae in upper 2/3 of the frond, distinctly narrowed, 5–35 by 0.5–2.5 cm, linear. *Soral patches* in one row between midrib and margin, quadrangular, 3–10 by 2–7 mm. Sporangia glabrous. Spores with small globules. — **Fig. 1c, 2.**

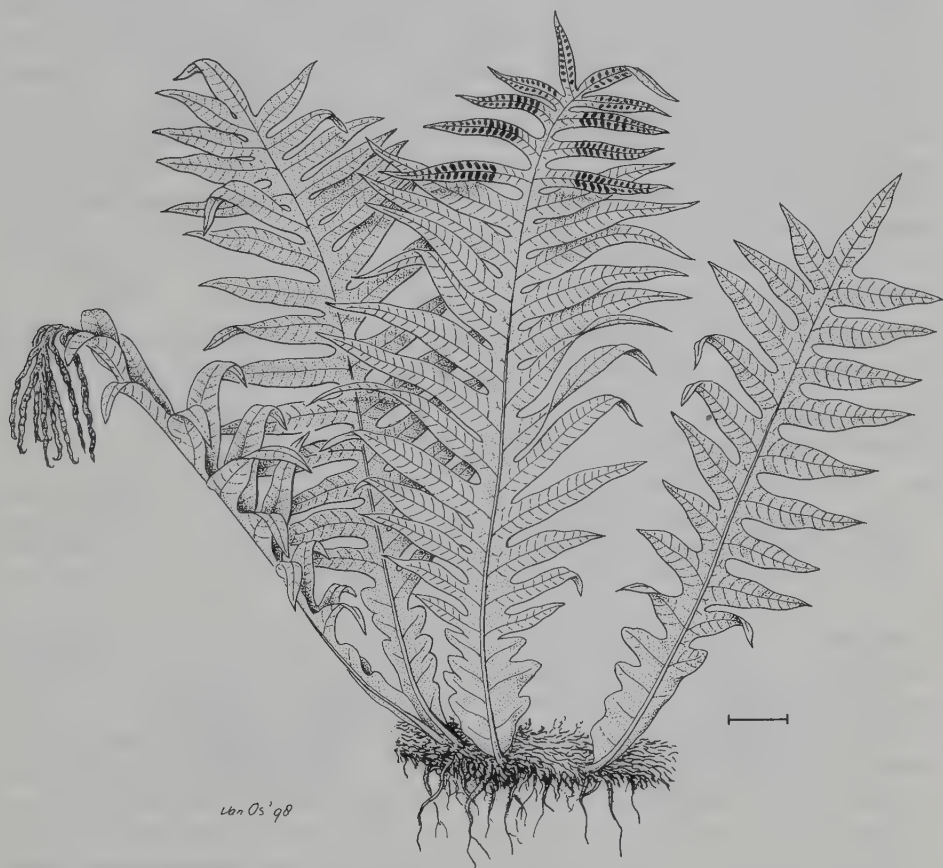


Fig. 2. *Aglaomorpha splendens* (Hook. & Bauer) Copel. Habit (a cultivated specimen in Leiden Botanical Garden). Scale bar = 7 cm. Drawing by J.H. van Os.

Distribution — *Malesia*: Philippines (Luzon, Negros, Mindanao).

Habitat — Usually epiphytic, forming a ring-shaped basket around tree trunks, sometimes epilithic; in primary forest, usually as a high epiphyte. Altitude 550–800 (–1300) m.

ARTHROMERIS

(P. H. Hovenkamp)

Arthromeris J. Sm., Hist. Fil. (1875) 110; Ching, Contr. Inst. Bot. Nat. Acad. Peiping II (3) (1933) 89; Hennisman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 213. — *Pleopeltis* sect. *Arthromeris* T. Moore, Index Filic. (1857) 78. — Type species: *Arthromeris wallichiana* (Spring) Ching.

Rhizome creeping to long-creeping. Anatomy: vascular strands with or without sclerified sheath, ground tissue parenchymatous, with or without sclerified strands. *Rhizome scales* pseudopeltate or peltate, not clathrate, persistent or more or less caducous. *Fronde* monomorphic, stipitate, pinnate; rarely simple, unifoliate. Lateral pinnules opposite, sessile or stipitate, articulate or the upper ones adnate, base auricled or cordate to gradually attenuate, terminal pinna not articulate, conform, or with distinct auricles at base, or hastate. Lamina green or glaucous, glabrous or short-hairy. Margin entire, cartilaginous, to 1 mm wide, flat. *Venation*: veins distinct, connecting veins and veinlets forming areoles with free included veinlets, free veinlets simple or forked, recurrent and excurrent, recurrent in marginal areole, ending in hydathodes. *Sori* on all pinnae, in one or several rows between midrib and margin, in single or double rows between adjacent pairs of veins, round or irregularly shaped, often somewhat elongated longitudinally or spreading along the veins, superficial. Sporangia stalked, capsule naked or with up to a few hairs apically. — **Fig. 3.**

Distribution — Himalayas to Taiwan, Indochina; in *Malesia*: Philippines (Luzon).

Habitat — Terrestrial or trunk epiphytes, in forests, at 600 to 2700 m altitude.

Arthromeris proteus (Copel.) Tagawa

Arthromeris proteus (Copel.) Tagawa, J. Jap. Bot. 27 (1952) 218; Copel., Fern Fl. Philipp. (1960) 510. — *Polypodium proteus* Copel., Philipp. J. Sc. 1, Suppl. (1906) 164. — *Pleopeltis proteus* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Crypsinus proteus* Copel., Gen. Fil. (1947) 206. — Type: *Copeland 1941bis* (n.v., photograph in Copeland 1906), Philippines, Luzon.

Rhizome c. 4 mm thick, short-creeping, phyllopods nearly contiguous. Anatomy: vascular strands 9, without sclerified sheath, ground tissue parenchymatous, sclerified strands absent. *Rhizome scales* pseudopeltate, c. 1 by 3.5 mm, spreading, brown, large-celled, margin dentate. *Fronde* monomorphic, stipitate, pinnate. Stipe to 17 cm, lamina to 20 cm long. Lateral pinnules opposite, 1–4 pairs, 3–3.5 cm distant, fully articulate or the middle pinnae with adnate acroscopic base, 6–7 by 1–1.5 cm, base asymmetric, basiscopic side rounded, acroscopic side narrowed, terminal pinna conform, not articulate, sometimes with distinct auricles at base. Margin sinuose, cartilaginous, entire. *Venation*: veins distinct, connecting veins and veinlets forming areoles with free included veinlets, free veinlets simple or forked, recurrent and excur-

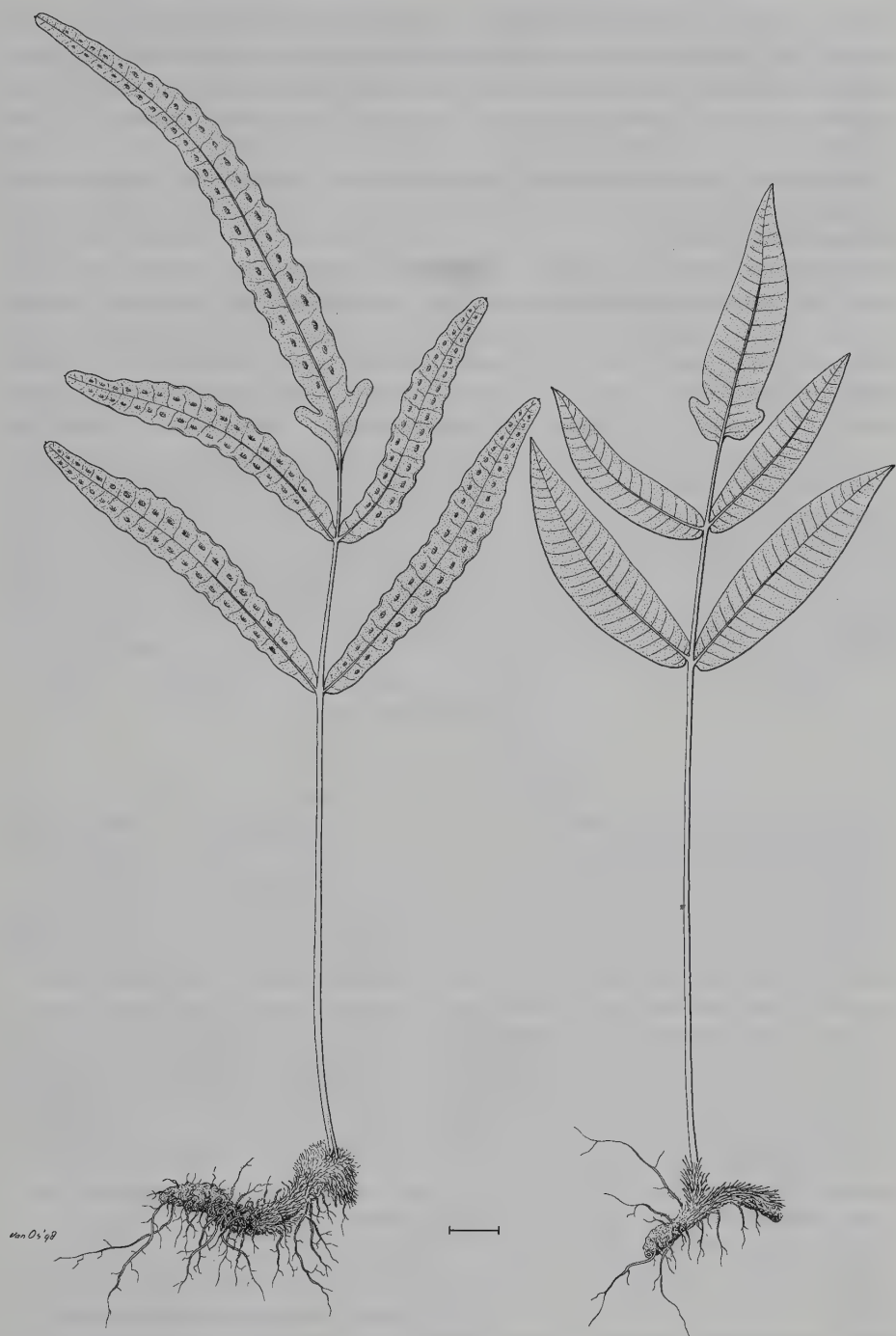


Fig. 3. *Arthromeris proteus* (Copel.) Tagawa. Habit (*Copeland PPE 150*). Scale bar = 1 cm. Drawing by J. H. van Os.

rent, recurrent in marginal areole, ending in hydathodes. Indument: sparse uniseriate, catenate, to 2 mm long hairs on the lower surface of rachis and costae. *Sori* on all pinnae, 1–3-seriate, in single rows between adjacent pairs of veins, round or irregularly shaped, often somewhat elongated longitudinally or spreading along the veins.

— **Fig. 3.**

Distribution — Assam, Burma, N Thailand, S China. *Malesia*: Philippines (Luzon).

Habitat — Terrestrial; on dry, rocky slopes in pine forest (one collection seen).

Altitude 1800–2200 m

Taxonomy — Copeland (1960) suggested that this may be a form of *A. lehmannii*. Indeed, in lamina shape and soral disposition it is similar to the specimens from Taiwan usually identified as *A. lehmannii*. However, both *A. proteus* and the Taiwan specimens differ from typical *A. lehmannii* in having sori predominantly in a single row between the veins, whereas *A. lehmannii* has sori nearly always in double rows. *Arthromeris proteus* differs from the Taiwan specimens in the rhizome, which has shorter internodes, and the rhizome scales, which have strikingly wide cells. The scales are mostly 8 or 9 cells wide directly above the point of attachment, whereas the corresponding number of cells in *A. lehmannii* (and in the specimens from Taiwan) is at least twice as many. In both soral disposition and rhizome and rhizome scale structure *A. proteus* appears to agree better with *A. tatsienense* (H. Christ) Ching. In the absence of a complete revision of *Arthromeris*, the exact identity of the few specimens from the Philippines cannot be ascertained.

BELVISIA

(P.H. Hovenkamp & N.A.P. Franken)

Belvisia Mirb., Hist. Nat. Gen. 4 (1803) 65; Hist. Nat. Vég. 3 (1803) 473; 5 (1803) 111; Underw., Mém. Torrey Bot. Club 6 (1899) 276; Copel., Gen. Fil. (1947) 191; Fern Fl. Philipp. (1960) 466; Pichi Serm., Webbia 9 (1953) 387; 31 (1977) 324; Holttum, Revis. Fl. Malaya 2 (1955) 153, f. 67 & 68; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 214; Hovenkamp & Franken, Blumea 37 (1993) 517. — Type species: *Belvisia spicata* (L. f.) Copel.

Hymenolepis Kaulf., Enum. (1824) 146, pl. 1, f. 9, nom. illeg., non Cassini (1817); Blume, Enum. Pl. Javae (1828) 200; Endl., Gen. Pl. (1836) 62, C. Presl (1851) 158; Fée, Gen. Filic. (1850–1852) 81, pl. 6B; T. Moore, Index Filic. (1857) 28, pl. 15A; Bedd., Ferns S. India (1863) 15, pl. 26; J. Sm., Ferns Brit. & For. (1866) 91, f. 19; Hist. Fil. (1875) 118; Copel., Polypod. Philipp. (1905) 110; Alderw., Malayan Ferns (1908) 727; Domin, Bibl. Bot. 85 (1915) 168; Alderw., Malayan Ferns Suppl. (1917) 432; Goebel, Ann. Jard. Bot. Buitenzorg 26 (1926) 108, pl. 7, f. 34–43; Bower, Ferns 3 (1928) 222, f. 731; C. Chr., Dansk Bot. Ark. 6 (1929) 54, f. 1; Backer & Posth., Varenfl. Java (1939) 228, f. 53, C. Chr. & Tardieu, Notul. Syst. 8 (1939) 185, Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 451, f. 53, 1–2. — Type species: *Hymenolepis ophioglossoides* Kaulf. (= *Belvisia spicata*).

Hyalolepis Kunze, Linnaea 23 (1850) 258, nom. illeg., non DC. (1837). — Type species: *Hyalolepis ophioglossoides* (Kaulf.) Kunze (= *Belvisia spicata*).

Macroplethus C. Presl, Epim. Bot. (1851) 141; Tagawa, Acta Phytotax. Geobot. 11 (1942) 232. — Type species: *Macroplethus platyrhynchus* (Kunze) C. Presl (= *Belvisia platyrhynchus*).

Epiphytic. *Rhizome* short- to long-creeping, approximately terete and covered with scales, dorsally with two rows of fronds, ventrally and laterally densely set with roots, with scattered sclerenchyma strands. *Rhizome scales* basifixed, pseudopeltate, ovate to linear-lanceolate, fully clathrate or with membranaceous margin, reddish to brown,

entire to dentate, with a varying number of glandular cells on the margin. *Fron*ds simple, entire. Stipes articulated to rhizome, basally terete, upwards adaxially grooved, sometimes winged. Lamina linear-lanceolate to linear, base cuneate, apex gradually narrowed or abruptly truncate to the narrow fertile part, olivaceous to brown when dry, dull, pergamentaceous, thinly covered with scattered, mostly quickly deciduous scales. *Venation*: veins anastomosing, forming areoles with many scattered free veinlets, free veinlets in the costal and marginal areoles all directed to the costa, in the other areoles predominantly directed to the costa; midrib distinct throughout the sterile and the fertile lamina, veins distinct or immersed, connecting veins and veinlets immersed. Fertile part linear-lanceolate to linear, with one elongated, sometimes interrupted, sorus at each side of the midrib usually fully covering the lamina between midrib and margin, sometimes leaving a narrow zone free along the midrib. Sporangia stalked, with 12–16 indurated annulus cells, mixed with peltate or basally attached paraphyses. Spores monolete, rugulate. — **Fig. 4.**

Distribution — Tropical Africa to tropical Asia and Polynesia, extending to South China, Tahiti, Rapa and Australia.

Taxonomy — *Belvisia* is a rather homogeneous genus of similar-looking plants, with the exception of *B. novoguineensis*. The number of taxa various authors have been able to distinguish has varied, between Christensen (1929), distinguishing 11 species and many forms and varieties, and more recent accounts. Hovenkamp & Franken (1993) recognise 8 species and 2 subspecies (6 and 1 occurring in Malesia). *Belvisia novoguineensis* is sometimes seen as intermediate to *Lemmaphyllum*.

Belvisia is close to *Lepisorus*, but is distinguished mainly by the coenosori.

KEY TO THE SPECIES

- 1a. Rhizome long-creeping, fronds scattered at intervals of up to 7 cm **3. B. novoguineensis**
- b. Rhizome short-creeping, fronds tufted or spaced at intervals of at most 2 cm 2
- 2a. Paraphyses peltate only (often completely absent in old sori), usually opaque with lumina of central cells almost entirely filled with wall material, lamina usually asymmetrically truncate below the spike **1. B. annamensis**
- b. Paraphyses with laterally affixed blades nearly always present, usually translucent, lamina usually gradually and symmetrically narrowed below the spike 3
- 3a. Rhizome scales with dentate to ciliate margin, all cells thick-walled 4
- b. Rhizome scales entire or almost so, central cells thick-walled, marginal cells thin-walled 5
- 4a. Sori completely covering the spike, the latter usually narrow, linear, 0.1–0.2 (rarely 1) cm wide **2. B. mucronata**
- b. Sori leaving a clear marginal and sometimes also a narrow costal zone free, spike relatively wide, to 2 cm wide **4. B. platyrhynchos**
- 5a. Rhizome short, fronds tufted, scales dull with a dark brown centre and a lighter margin, lamina generally 1–2 cm wide **5. B. spicata**
- b. Rhizome more widely creeping, fronds scattered at intervals of up to 2 cm, scales uniformly light brown, glossy or iridescent, lamina generally 3 or 4, sometimes 6 cm wide **6. B. validinervis**

1. *Belvisia annamensis* (C. Chr.) Tagawa

Belvisia annamensis (C. Chr.) Tagawa, Acta Phytotax. Geobot 22 (1967) 107; Hovenkamp & Franken, Blumea 37 (1993) 519, f. 2a, 3b. — *Hymenolepis annamensis* C. Chr., Dansk Bot. Ark. 6 (1929) 68, f. 1e; C. Chr. & Tardieu, Notul. Syst. 8 (1939) 185; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 452, f. 35, 1-2. — *Macroplethus annamensis* Tagawa, Acta Phytotax. Geobot. 11 (1942) 234. — Type: *Poilane 8010* (P), Annam.

Gymnopteris spicata Bedd. var. *B. latifrons* Bedd., Suppl. Ferns Brit. India (1892) 104. — *Hymenolepis spicata* C. Presl var. *latifrons* Alderw.; Malayan Ferns (1908) 729. — Syntypes: *King 1100* (BO; iso M), Perak; *Day s.n.* (n.v.), Perak.

Hymenolepis callifolia H. Christ var. *paltonioides* C. Chr., Dansk Bot. Ark. 6 (1929) 67. — Syntypes: *Haviland s.n.* (K), Sarawak; *Macleay s.n.* (K), Borneo.

Rhizome short-creeping, internodes not elongated, 2–4 mm thick. *Rhizome scales* ovate-lanceolate to linear-lanceolate, 4.8–8.3 by 0.9–2.1 mm, index 3.8–5.6, base dentate, acumen narrowed, dentate near the base, sometimes with a narrow entire filiform apex, reddish brown to black, all cell walls strongly thickened. Stipes 1–4 cm long, 1–2 mm thick, lamina linear-lanceolate, 15–30 by 2–5 cm, index 6–9, base gradually narrowed, apex more or less abruptly truncate; spike 5–25 by 0.4–0.7 cm, index 8–60. *Sori* often extending downwards to well below the narrowed spike, medially between midrib and margin, leaving a medial and marginal free zone, paraphyses peltate, with circular blade, 0.1–0.4 mm diam., brownish to black, margin toothed, cell walls strongly thickened in the mature paraphyses. Spores rugulate, 40–60 by 25–40 μm . — **Fig. 4a.**

Distribution — *Malesia*: Peninsular Malaysia, Borneo; outside *Malesia*: Indochina.

Habitat — Epiphytic or on rocks in evergreen forest. Altitude from sea level to 1900 m.

2. *Belvisia mucronata* (Fée) Copel.

Belvisia mucronata (Fée) Copel., Gen. Fil. (1947) 192; Wagner & Grether, Occ. Pap. B. P. Bish. Mus. 19 (1948) 87; Holttum, Revis. Fl. Malaya 2 (1955) 155; Copel., Fern Fl. Philipp. (1960) 469; Brownlie in Fl. Nouv. Caléd. et Dép. 3 (1969) 283, pl. 38, f. 4; Morton, Amer. Fern J. 6 (1970) 43; De Vol & Kuo in Fl. Taiwan 1 (1975) 168, pl. 57; Hovenkamp & Franken, Blumea 37 (1993) 521, f. 1c, d; 3c. — *Hymenolepis mucronata* Fée, Gen. Filic. (1850-1852) 81, pl. 6, f. 1; C. Chr., Dansk Bot. Ark. 6 (1929) 62; Copel., Occ. Pap. B. P. Bish. Mus. 14 (1938) 69; Backer & Posth., Varenfl. Java (1939) 230. — *Macroplethus mucronatus* Tagawa, Acta Phytotax. Geobot. 11 (1942) 234. — Type: *Cuming 92* (P; iso BM, G, UC, US, W), Philippines, Luzon.

[*Acrostichum callifolia* Harrington, J. Linn. Soc. Bot. 16 (1877) 34 ('*callaefolium*'), nom. nud.] — *Hymenolepis callifolia* H. Christ, Ann. Jard. Bot. Buitenzorg II, 5 (1905) 128 ('*callaefolia*'); Alderw., Malayan Ferns (1908) 729; Copel., Sarawak Mus. J. 2 (1917) 410; C. Chr., Dansk Bot. Ark. 6 (1929) 66, f. 1b, c; Backer & Posth., Varenfl. Java (1939) 230; Holttum, Revis. Fl. Malaya 2 (1955) 156, f. 68. — *Belvisia callifolia* Copel., Gen. Fil. (1947) 192. — *Macroplethus callifolius* Tagawa, Acta Phytotax. Geobot. 11 (1942) 234. — Type: *Hallier 632* (BO, photograph in BM), Borneo.

Hymenolepis spicata forma *longipaleacea* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 16; Malayan Ferns Suppl. (1917) 432; Nova Guinea 14 (1924) 26. — Type: *Docters van Leeuwen 11* (BO), Java.

Hymenolepis spicata forma *squamulifera* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 19; Malayan Ferns Suppl. (1917) 433; Nova Guinea 14 (1924) 26. — Type: *Gjellerup 805* (BO), New Guinea.

- Hymenolepis spicata* var. *graminifolia* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 12 (1913) 530; Alderw., Malayan Ferns Suppl. (1917) 433. — *Hymenolepis mucronata* var. *nigropunctata* forma *graminifolia* C. Chr., Dansk Bot. Ark. 6 (1929) 64. — Type: *Keysser* 290 (BO), New Guinea.
- Hymenolepis spicata* var. *novoguineensis* Rosenst., Hedwigia 56 (1915) 353; Alderw., Malayan Ferns Suppl. (1917) 433. — Type: *Bamler* 60 (B; iso L, P), New Guinea.
- Hymenolepis spicata* var. *bakhuizenii* Alderw., Malayan Ferns Suppl. (1917), corr. 59; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 27. — Type: *Bakhuizen van den Brink* s. n. (?BO, not traced), Java.
- Hymenolepis mucronata* var. *nigropunctata* C. Chr., Dansk Bot. Ark. 6 (1929) 64. — Type: *Ledermann* 13068 (B), New Guinea.
- Hymenolepis mucronata* var. *nigropunctata* forma *latior* C. Chr., Dansk Bot. Ark. 6 (1929) 65. — Syntypes: *Kaudern* s. n. (not located), Celebes; *Korthals* 109 (B), locality not given.
- Hymenolepis ophioglossoides* auct. non Kaulf.: Kaulf., Enum. (1824) 146, pl. 1, 9, p. p.; Blume, Enum. Pl. Javae (1828) 200; Kunze, Linnaea 23 (1850) 258.

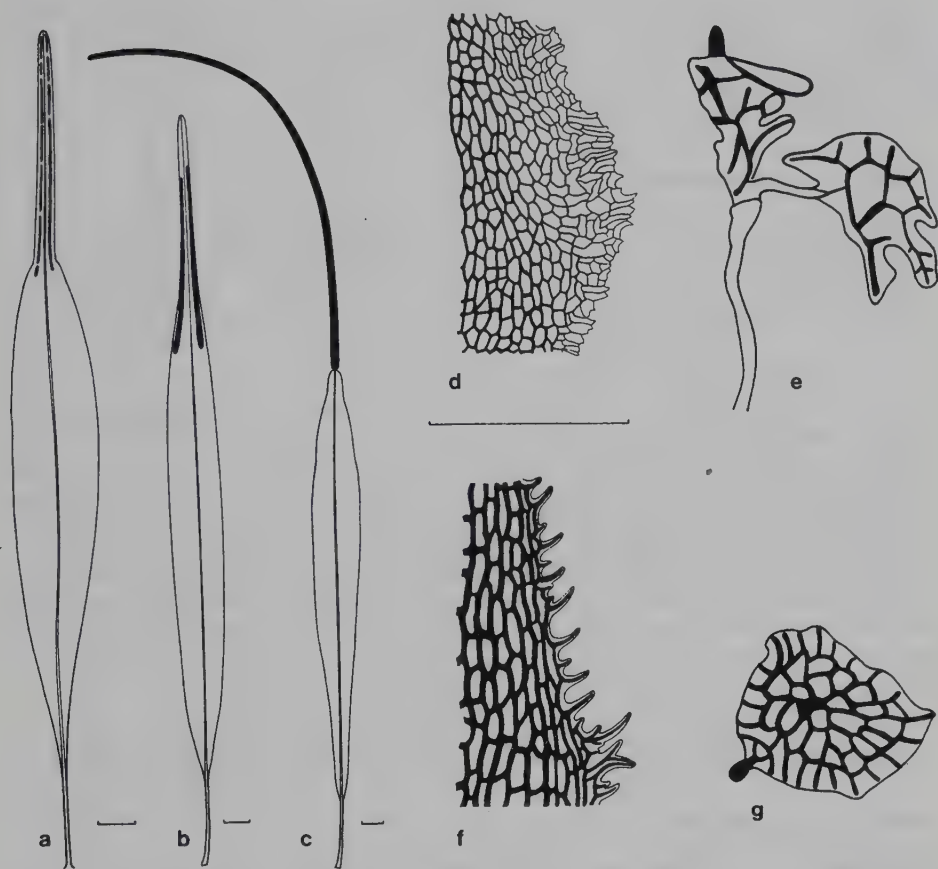


Fig. 4. *Belvisia annamensis* (C. Chr.) Tagawa. a. Fertile frond. — *B. novoguineensis* (Rosenst.) Copel. b. Fertile frond. — *B. spicata* (L. f.) Copel. c. Fertile frond; d. margin of rhizome scale; e. paraphyse blade. — *B. mucronata* (Fée) Copel. f. Margin of rhizome scale; g. paraphyse blade. — Scale bars: a–c = 1 cm, d & f = 1 mm, e & g $\times 125$. Reproduced from Blumea 37 (1993).

var. **mucronata**

Rhizome short-creeping, internodes not elongated, 2–5 mm thick. *Rhizome scales* ovate-oblong, ovate-lanceolate to linear-lanceolate, 2.5–8.5 by 0.5–2 mm, index 3–8, margin minutely to distinctly dentate, acumen contracted, apex acute, reddish brown to black, all cells with thickened cell walls. Stipes up to 6 cm long, 1–2 mm thick, lamina linear to linear-lanceolate, 10–50 by 1–5 cm, index 5–22, narrowed towards base and apex, spikes linear, 3–25 by 0.3–0.7 cm, index 3–85. *Sori* close to the midrib, completely covering the lower surface when ripe, paraphyses with laterally affixed or peltate blades, the latter round, 0.1–0.65 mm diam., brownish to black, margin entire to toothed, cells with thick walls. Spores rugulate, 40–90 by 60 μm . — **Fig. 4f, g.**

Distribution — Throughout *Malesia*; outside *Malesia*: Sri Lanka, Indochina, Taiwan, Australia, Pacific.

Habitat — Epiphytic on all kinds of trees or on rocks; in primary and secondary forest. Altitude 0–1500 (rarely up to 4000) m.

Note — A very variable species, particularly in the width of the fronds. A few specimens from New Guinea with extremely narrow fronds, 0.3–0.9 cm wide, have been described as var. *graminifolia* Rosenst. They do not differ from normal specimens in any other character.

3. *Belvisia novoguineensis* (Rosenst.) Copel.

Belvisia novoguineensis (Rosenst.) Copel., Gen. Fil. (1947) 192; Hovenkamp & Franken, *Blumea* 37 (1993) 523, f. 2c, 3d. — *Paltonium novoguineense* Rosenst., *Nova Guinea* 8 (1912) 729. — *Lemmaphyllum novoguineense* C. Chr., *Dansk Bot. Ark.* 6 (1929) 51. — *Hymenolepis novoguineensis* C. Chr., *Index Filic. Suppl.* 3 (1934) 113. — *Macroplethus novoguineensis* Tagawa, *Acta Phytotax. Geobot.* 11 (1942) 234. — Type: *von Römer s.n.*, XI-1909 (L, BO), New Guinea.

Rhizome long-creeping, internodes 2–7 cm long, slender, 0.8–1.5 mm thick. *Rhizome scales* 2.5–5 by 0.9–1.3 mm, thin, translucent, red-brown to fuscous, margin minutely toothed, apex rounded to acute, all cells thin-walled. Stipes 2–7 cm long, 0.7–1.2 mm thick, lamina ovate-lanceolate to linear, 5–30 by 1–3 cm, index 4–20, gradually narrowed to the base and apex, glabrous or with a few scales on the abaxial side of stipe and costa; spike from a wide base gradually narrowed, 4–17 by 0.5–1.5 cm (basal width). *Sori* sometimes interrupted, marginal, leaving a sterile zone near midrib and margin, especially in the lower, widened part of the spike, paraphyses with laterally affixed or peltate blades, laterally affixed blades 20–30 by 5–30 mm, sometimes irregularly lobed; peltate blades 0.3–0.5 mm diam.; brownish, margin entire. Spores rugulate, 60–80 by 50–60 μm . — **Fig. 4b.**

Distribution — *Malesia*: New Guinea; outside *Malesia*: New Ireland.

Habitat — Epiphytic in mid-montane, wet or mossy forest. Altitude 1100–3000 m.

4. *Belvisia platyrhynchos* (Kunze) Copel.

Belvisia platyrhynchos (Kunze) Copel., Gen. Fil. (1947) 192; Fern Fl. Philipp. (1960) 467; Zamora & Co, *Guide Philipp. Flora & Fauna* II (1986) 147; Hovenkamp & Franken, *Blumea* 37 (1993) 523, f. 2d, 3e. — [*Gymnopteris platyrhynchos* J. Sm., *J. Bot. (Hook.)* 3 (1841) 403, nom. nud.] — *Hymenolepis platyrhynchos* Kunze, *Farnkr.* 1 (1842) 101; Fée, *Gen. Filic.* (1850–1852) 82; J. Sm., *Hist. Fil.* (1875) 119; Copel., *Polypod. Philipp.* (1905) 110; Alderw., *Malayan Ferns*

(1908) 729; Malayan Ferns Suppl. (1917) 433; C. Chr., Dansk Bot. Ark. 6 (1929) 68; Copel., Univ. Calif. Publ. Bot. 16 (1929) 101. — *Macroplethus platyrhynchus* C. Presl, Epim. Bot. (1851) 142; Tagawa, Acta Phytotax. Geobot. 11 (1942) 234. — *Acrostichum platyrhynchus* Hook., Sp. Fil. 5 (1864) 280; Baker, Syn. Fil., ed. 2 (1874) 424; Harrington, J. Linn. Soc. Bot. 16 (1878) 34; H. Christ, Ann. Jard. Bot. Buitenzorg 15 (1898) 180; Bull. Herb. Boiss. 6 (1898) 206. — *Taenitis platyrhynchus* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1869) 173. — Type: *Cuming 196* (B; iso G, K, L, P, W), Philippines, Luzon.

Hymenolepis platyrhynchus var. *glauca* Copel., Leaflet Philipp. Bot. 3 (1910) 847. — *Hymenolepis glauca* C. Chr., Dansk Bot. Ark. 6 (1929) 62. — *Macroplethus glauca* Tagawa, Acta Phytotax. Geobot. 11 (1942) 62. — *Belvisia glauca* Copel., Gen. Fil. (1947) 192; Fern Fl. Philipp. (1960) 467; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 147. — Type: *Elmer 11444* (K; iso BM, BO, G, L, P, US, W), Philippines, Mindanao.

Rhizome short-creeping, internodes not elongated, 2–6 mm thick. *Rhizome scales* ovate-oblong to ovate-lanceolate, 6.8–10.5 by 1.5–3 mm, index 3–5, sometimes narrowed towards the acumen, apex acute; margin long-dentate; reddish brown, cells with thickened walls. *Fronde*s sessile to clearly stalked, stipe up to 1(–4) cm long, 2–4 mm thick; lamina linear-lanceolate to linear, 5–75 by 1–5 cm, index 5–20; narrowed towards base and apex, somewhat constricted below the spike; spike lanceolate to linear-lanceolate, 2–10 by 0.5–2 cm, index 3–11.5. *Sori* close to the midrib, when ripe covering the midrib and leaving a marginal zone 1–5 mm wide free, paraphyses with laterally affixed or peltate blades, laterally affixed blades flat or cylindrical, 0.15–0.4 by 0.04–0.3 mm, peltate blades 0.25–0.65 mm wide, margin entire, cells with thick walls. Spores rugulate, 40–90 by 25–60 µm.

Distribution — *Malesia*: Philippines (Luzon, Mindoro, Mindanao), New Guinea (Japen I.).

Habitat — Epiphytic; in primary and secondary forest or at high altitudes in open areas (Zamora & Co, l. c.). Altitude from sea level to 2300 m.

5. *Belvisia spicata* (L. f.) Copel.

Belvisia spicata (L. f.) Mirb. ex Copel., Gen. Fil. (1947) 192; Hovenkamp & Franken, Blumea 37 (1993) 524; f. 1a, b, 2e, 3f. — *Acrostichum spicatum* L. f., Suppl. Pl. (1781) 444; Sm., Plant. Ic. Hact. Ined. (1790) pl. 46; Cav., Descr. (1801) 237; Baker, Syn. Fil., ed. 2 (1874) 424; Racib., Pterid. Buitenzorg (1898) 51. — *Schizaea spicata* Sm., Mém. Acad. Sci. Turin 5 (1793) 43. — *Onoclea spicata* Sw., J. Bot. (Schrad.) 1800 (2) (1801) 299; Syn. Fil. (1806) 110, 303. — *Lomaria spicata* Willd., Sp. Pl. 5 (1810) 289. — *Hymenolepis spicata* C. Presl, Epim. Bot. (1851) 159; T. Moore, Index Filic. (1857) 28, pl. 15, f. A; Hook., Fil. Exoc. (1859) pl. 78; Bedd., Ferns S. India (1863) 15, pl. 46; Hook., Sp. Fil. 5 (1864) 280; J. Sm., Ferns Brit. & For. (1866) 92, f. 19; Hist. Fil. (1875) 119; Bedd., Suppl. Ferns S. India (1876) 27; Copel., Polypod. Philipp. (1905) 110; Alderw., Malayan Ferns (1908) 728; Domin, Bibl. Bot. 85 (1915) 168; Alderw., Malayan Ferns Suppl. (1917) 432, corr. 59; Copel., Sarawak Mus. J. 2 (1917) 410; Alderw., Nova Guinea 14 (1924) 26; Ridl., J. Malay Br. Roy. As. Soc. 4 (1926) 113; C. Chr., Dansk Bot. Ark. 6 (1929) 57; Copel., Univ. Calif. Publ. Bot. 16 (1929) 101; C. Chr., Dansk Bot. Ark. 7 (1932) 160; Ching, Sunyatsenia 5 (1940) 259. — *Taenitis spicata* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 173. — *Gymnopteris spicata* C. Presl, Tent. Pterid. (1836) 244; Bedd., Handb. Ferns Brit. India (1883) 431, f. 261. — *Macroplethus spicata* Tagawa, Acta Phytotax. Geobot. 11 (1942) 235. — Type: *Commerson s. n.* (P), Mauritius.

Hymenolepis revoluta Blume, Enum. Pl. Javae (1828) 201; Kunze, Farnkr. 1 (1842) 101, pl. 47, f. 2; Fée, Gen. Filic. (1850-1852) 82; C. Presl, Epim. Bot. (1851) 160; C. Chr., Dansk Bot. Ark. 6 (1929) 58; Backer & Posth., Varenfl. Java (1939) 229, f. 53; C. Chr. & Tardieu, Notul. Syst.

- 8 (1939) 185; Copel., Occ. Pap. B. P. Bish. Mus. 14 (1939) 69; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 452. — *Hyalolepis revoluta* Kunze, Linnaea 23 (1850) 258. — *Taenitis revoluta* Mett., Fil. Hort. Bot. Lips. (1856) 28. — *Taenitis spicata* forma *angustata* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 173. — *Macroplethus revoluta* Tagawa, Acta Phytotax. Geobot. 11 (1942) 234. — *Belvisia revoluta* Copel., Gen. Fil. (1947) 192; Holttum, Revis. Fl. Malaya 2 (1955) 155, f. 67; Copel., Fern Fl. Philipp. (1958) 468. — Type: *Blume s. n.* (BO; iso L), Java.
- Hyalolepis revoluta* var. *planiuscula* Kunze, Linnaea 23 (1850) 258. — *Taenitis revoluta* var. *planiuscula* Mett., Fil. Hort. Bot. Lips. (1856) 28, pl. 15, f. 13–16. — *Hymenolepis revoluta* var. *planiuscula* C. Chr., Dansk Bot. Ark. 6 (1929) 58; Morton, Amer. Fern J. 6 (1970) 44. — Type: cultivated specimens in Hortus Bonn, Leipzig (not traced), Java.
- Hymenolepis rigidissima* H. Christ, Bull. Herb. Boiss. II, 6 (1906) 990; Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 5 (1908) 370; Alderw., Malayan Ferns (1908) 728; Malayan Ferns Suppl. (1917) 432. — Type: *Loher s. n.*, 18-IV-1905 (P), Philippines, Luzon, Batay.
- Hymenolepis spicata* var. *tenella* Alderw., Malayan Ferns (1908) 729. — Type: *Zollinger s. n.* (BO, L).
- Hymenolepis spicata* var. *costulata* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 16; Malayan Ferns Suppl. (1917) 433. — *Hymenolepis revoluta* var. *costulata* C. Chr., Dansk Bot. Ark. 6 (1929) 59. — Type: *Burck s. n.* (BO), Sumatra.
- Hymenolepis spicata* forma *minima* Alderw., Malayan Ferns Suppl. (1917) 432. — Type: not known.

Rhizome short-creeping, internodes not elongated, 2–4 mm thick. *Rhizome scales* ovate, ovate-lanceolate or narrowly triangular, 1.7–4.1 by 1–1.5 mm, index 1.7–3, apex acute to rounded, often recurved; margin usually entire, rarely dentate; central cells with thickened walls, marginal cells in a 0.2–0.3 mm wide membranaceous zone with thin walls. Stipes 0.5–4 cm long, 1–2 mm thick; lamina linear-lanceolate to linear, 8–30 by 0.3–2 cm, index 5–70; narrowed towards base and apex; spikes linear, 2–25 by 0.2–0.4 cm, index 5–100. *Sori* covering the lamina when ripe, situated close to the midrib; paraphyses with irregularly branched and lobed blades, cells with thick walls. Spores rugulate, 40–90 by 25–60 μm , index 1.5–1.7. — **Fig. 4c–e.**

Distribution — Throughout *Malesia*; outside *Malesia*: tropical Africa, Sri Lanka, Indochina, Australia (Queensland), New Caledonia, Fiji, Tahiti.

Habitat — Epiphytic or epilithic; in primary or secondary forest. Common in mountainous areas. Altitude up to 3000 m.

Notes — 1. In *Malesia* this widespread species is often very close to *B. validinervis*, and may be hybridising with the latter.

2. Superficially, this species is very similar to *B. mucronata*, and the two species have frequently been confused or collected together. The main difference is found in the rhizome scales, which are clearly dentate and clathrate to the margin in *B. mucronata*, entire and hyaline near the margin in *B. spicata*.

6. *Belvisia validinervis* (Kunze) Copel.

- Belvisia validinervis* (Kunze) Copel., Gen. Fil. (1947) 192; Fern Fl. Philipp. (1960) 467; Hovenkamp & Franken, Blumea 37 (1993) 526, f. 2f. — *Hymenolepis validinervis* Kunze, Bot. Zeit. (Berlin) 6 (1848) 122; C. Presl, Epim. Bot. (1851) 160; Fée, Gen. Filic. (1850–1852) 82; C. Chr., Dansk Bot. Ark. 6 (1929) 60; Backer & Posth., Varenfl. Java (1939) 229. — *Taenitis validinervis* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 173, t. 7, f. 7–10. — *Macroplethus validinervis* Tagawa, Acta Phytotax. Geobot. 11 (1942) 235. — *Hymenolepis spicata* var. *validinervis* Alderw., Malayan Ferns Suppl. (1917) corr. 59. — Type: *Zollinger 2312* (B; iso BM, BO, G, P), Java.

- Hymenolepis validinervis* var. *celebica* C. Chr., Dansk Bot. Ark. 6 (1929) 61. — Type: *Bünnemeijer 12032* (B; iso BM, BO, M, L, P), Celebes.
- Hymenolepis spicata* var. *brachystachys* Hook., Gard. Ferns (1862) t. 3; Spec. Fil. 5 (1864) 280; Baker, Syn. Fil., ed. 2 (1874) 424. — *Hymenolepis brachystachys* J. Sm., Ferns Brit. & For. (1866) 92; Alderw., Malayan Ferns (1908) 729; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 51. — *Acrostichum brachystachys* Racib., Pterid. Buitenzorg (1898) 51. — Type: Tab. 3 in Hooker, Garden Ferns, l.c.
- Hymenolepis brachystachys* var. *mirabilis* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 28, t. 4. — Type: Alderwerelt l.c.: plate 4 (Wigman cult.).
- Hymenolepis squamata* C. Chr., Dansk Bot. Ark. 6 (1929) 59. — *Macroplethus squamata* Tagawa, Acta Phytotax. Geobot. 11 (1942) 235. — *Belvisia squamata* Copel., Gen. Fil. (1947) 192; Fern Fl. Philipp. (1960) 468. — Type: *Mearns 4205* (B; iso MICH, US, W), Luzon.
- Hymenolepis squamata* var. *borneensis* C. Chr., Dansk Bot. Ark. 6 (1929) 60. — *Belvisia squamata* var. *borneensis* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 98. — Type: *Clemens 10664* (B; iso MICH, US), Borneo.

a. var. *validinervis*

Rhizome creeping, internodes 0.5–2 cm, 2–6 mm thick. *Rhizome scales* large, ovate-oblong to ovate-lanceolate, 2–6 by 1–3 mm, attenuate to an acute or rounded apex, margin entire or minutely dentate; light red- or grey-brown, glossy and often iridescent, cell walls thin, central cells with slightly more thickened walls than the marginal cells. *Fronds* subsessile to clearly stalked, stipes up to 15 cm long, 1–2.5 mm thick, lamina linear, 5–60 by 0.3–4 cm, narrowed to base and apex, glabrous or with a few to many, often irregularly shaped scales, especially along the costa. Spike continuous with lamina, not constricted at the base, relatively wide to linear, 2–25 by 0.2–0.8 cm, index 5–85. *Sori* close to the midrib but covering the entire lamina when ripe. Paraphyses with laterally affixed or peltate blades or irregularly lobed, laterally affixed blades flat or cylindrical, 0.10–0.30 by 0.04–0.20 mm, peltate blades 0.25–0.65 mm wide, margin entire or incised. Spores rugulate, 40–90 by 25–60 μm .

Distribution — Throughout *Malesia*. Outside *Malesia*: New Ireland, New Hebrides, New Caledonia.

Habitat — Epiphytic or epilithic; in primary and secondary^a montane forest. Altitude 1200–4000 m (rarely lower).

Note — *Belvisia validinervis* is not always sharply distinct from *B. spicata*, and may be hybridising with the latter. Typical *B. validinervis* is best recognised by the scales, and the moderately spaced fronds, and, less typical, by wide spikes and a subsessile lamina.

b. var. *longissima* (Holttum) Hovenkamp & Franken

Belvisia validinervis var. *longissima* (Holttum) Hovenkamp & Franken, Blumea 37 (1993) 527, f. 2g. — *Belvisia longissima* Holttum, Blumea 14 (1966) 328. — Type: *Pullen 5356* (K; iso L), New Guinea.

Differs from the type variety: Fronds larger, stipes to 40 cm long, lamina 65–220 cm by 2–6 cm, shortly narrowed to the spike, the latter 60 by 0.4–0.6 cm.

Distribution — *Malesia*: Sulawesi, New Guinea.

Habitat — Epiphytic, especially on *Pandanus*; in montane forest. Altitude 2200–3500 m.

CHRISTIOPTERIS

(E. Hennipman, P.H. Hovenkamp & W.L.A. Hetterscheid)

Christiopteris Copel. in Perkins, *Fragm. Fl. Philipp.* (1905) 188; Philipp. J. Sc., Bot. 12 (1917) 311; Bower, *The Ferns* 3 (1928) 213; Copel., *Gen. Fil.* (1947) 178; Holttum, *Revis. Fl. Malaya* 2 (1954) 210; Copel., *Fern Fl. Philipp.* (1960) 456; Hennipman & Hetterscheid, *Bot. Jahrb. Syst.* 105 (1984) 3; Hennipman et al. in Kramer & Green, *Fam. & Genera Vasc. Pl.* 1 (1990) 217. — Type species: *Christiopteris sagitta* (H. Christ) Copel.

Rhizome long-creeping, 5–6 mm thick. internodes 5–8 cm long. Anatomy: sclerenchyma strands usually present, sometimes inconspicuous. *Rhizome scales* pseudopeltate or peltate, isotoechous, often excurrent in a long subulate apex. *Fronde*s strongly dimorphic, stipitate, trilobed, the fertile lamina contracted, completely covered by a linear coenosorus. *Venation* obscure, strongly anastomosing, with excurrent and re-current free veinlets. Margin thickened, cartilaginous, entire. *Sori* forming longitudinal coenosori completely or nearly completely covering the lamina of the fertile fronds. — **Fig. 5.**

Distribution — India to Indochina; in *Malesia*: Philippines.

Taxonomy — A small genus of somewhat uncertain position. After its foundation by Copeland (1905), several trilobed species have been variously in- and excluded. The two species that are at the moment still included have no evident relations to other genera of *Polypodiaceae*, but the possibility cannot be excluded that their joint inclusion in this genus is based on convergences.

KEY TO THE SPECIES

- 1a. Sterile fronds trilobed, lobes broadly triangular, widest at their base, lamina base deeply cordate **1. *C. sagitta***
- b. Sterile fronds deeply trifid, lobes elliptic, narrowed at their base, lamina base truncate **2. *C. tricuspis***

1. *Christiopteris sagitta* (H. Christ) Copel.

Christiopteris sagitta (H. Christ) Copel. in Perkins, *Fragm. Fl. Philipp.* (1905) 188; Philipp. J. Sc. 1, Suppl. (1906) 157, pl. 13; Fern Fl. Philipp. (1960) 457; Hennipman & Hetterscheid, *Bot. Jahrb. Syst.* 105 (1984) 3. — *Polypodium sagittum* H. Christ, *Bull. Herb. Boiss.* 6 (1898) 199. — Syntypes: *Loher s.n.* (P), *Loher 877* (K).

Christiopteris copelandii H. Christ, *Bull. Herb. Boiss.* II, 6 (1906) 990; Bower, *The Ferns* 3 (1928) 218; Copel., *Fern Fl. Philipp.* 3 (1960) 457. — Syntypes: *Copeland*, *Whitford* (P, n.v.).

Rhizome dorsiventrally slightly flattened, often grooved when dry, internodes to 8 cm long. Anatomy: vascular strands c. 12, with a thin sclerified sheath, sclerenchyma strands few to c. 50, often inconspicuous. *Rhizome scales* peltate, 5–10 by 0.7–1 mm, base dentate to irregularly lacerate, gradually narrowed to an appressed or spreading, light brown acumen with short acicular apex, or more suddenly contracted into a strongly squarrose or recurved, long, subular dark brown acumen with a long filiform apex. *Fertile fronds*: stipe 14–20 cm, lamina deeply trisected, base narrowly cuneate, middle lobe 12–22 by 0.4–0.6 cm, lateral lobes 8–15 by 0.5 cm. *Sterile*

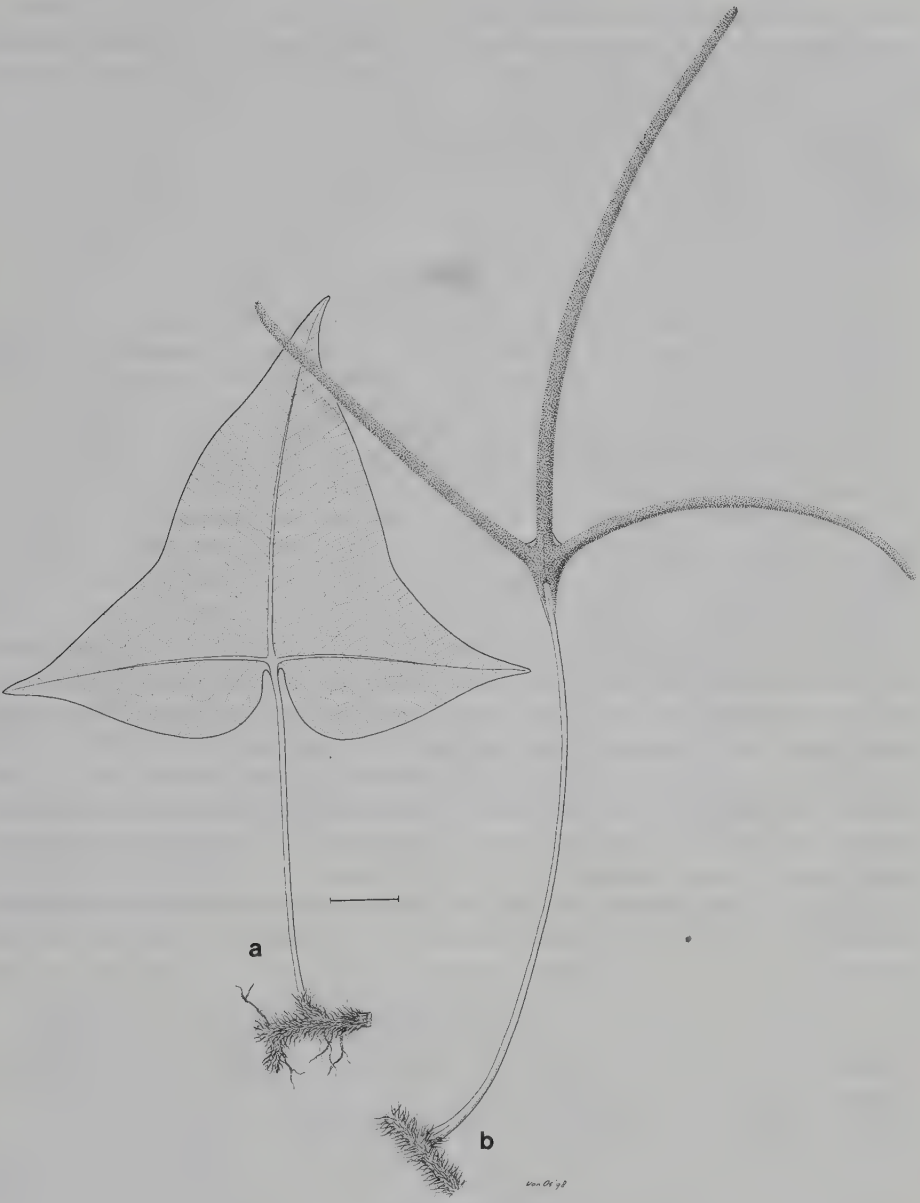


Fig. 5. *Christiopteris sagitta* (H. Christ) Copel. a. Sterile frond; b. fertile frond (Price 443). Scale bar = 2 cm. Drawing by J.H. van Os.

fronds: stipe 6–20 cm; lamina hastate, in outline as wide as or wider than long, 12–21 by 12–25 cm, base deeply cordate, middle lobe 10–19 by 5–8 cm, lateral lobes 6–13 by 3.5–6 cm, apex of all lobes rounded to wide-acuminate. *Sori* forming uninter-

rupted single longitudinal coenosori, covering nearly all the lamina of the fertile fronds. Sporangia long-stalked, capsules c. 0.3 mm long, with 12–14 indurated annulus cells. Spores narrowly bean-shaped, 50–60 by 30–35 μ m, hyaline, nearly smooth, with scattered small globules. — **Fig. 5.**

Distribution — *Malesia*: Philippines (Luzon, Mindanao).

Habitat — Pendulous epiphyte, hanging from fern clump, or on vertical rockface. Altitude 900–1600 m.

2. *Christiopteris tricuspis* (Hook.) H. Christ

Christiopteris tricuspis (Hook.) H. Christ, J. Bot. 21 (1908) 273; Copel., Philipp. J. Sc., Bot. 12 (1917) 332; Bower, The Ferns 3 (1928) 214, f. 722–726, pl. s.n. (frontispiece); Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 450, f. 52: 2; Holttum, Revis. Fl. Malaya 2 (1954) 211; Hennipman & Hetterscheid, Bot. Jahrb. Syst. 105 (1984) 4. — *Acrostichum tricuspe* Hook., Sp. Fil. 5 (1864) 272, pl. 304. — *Gymnopteris tricuspis* Bedd., Ferns Brit. India (1866) t. 53, cum descr.; Suppl. Ferns Brit. India (1876) 27; Handb. Ferns Brit. India (1883) 434, f. 263. — *Cheiropleuria tricuspe* J. Sm., Hist. Fil. (1875) 139. — *Leptochilus tricuspis* C. Chr., Index Filic. (1906) 388; K. Schum., Flora 108 (1915) 250. — Type: *Atkinson s.n.* (K, n.v.).

Christiopteris eberhardtii H. Christ, J. Bot. (Morot) II, 1 (1908) 272; Copel., Philipp. J. Sc., Bot. 12 (1917) 332; Bower, The Ferns 3 (1928) 218; Copel., Gen. Fil. (1947) 179; Holttum, Revis. Fl. Malaya 2 (1954) 211. — Type: *Eberhardt 84* (P).

Rhizome: internodes to 5 cm long. Anatomy: vascular strands c. 13, without sclerenchymatous sheath, sclerenchyma strands many, scattered. *Rhizome scales* spreading to erect, pseudopeltate, to 8 by 1 mm, from a denticulate base gradually narrowed into to a long entire acumen, glossy castaneous. *Fronds* pendulous. Sterile fronds: stipe 47–63 cm; base truncate or shortly decurrent on the stipe, middle lobe to 75 by 6.6 cm, widest below to above the middle, apex acute to acuminate; lateral lobes shorter, to 42 cm long, otherwise similar, often somewhat curved upwards. Fertile fronds: stipe to 78 cm, middle lobe to 67 cm or longer, c. 1 cm wide, linear, lateral lobes to 55 cm long, otherwise similar. *Sori* forming uninterrupted single longitudinal coenosori, covering nearly all the lamina of the fertile fronds. Ripe sporangia not observed.

Distribution — India, Indochina, Hainan; in *Malesia*: Peninsular Malaysia (Fraser's Hill, 3 coll.).

Habitat — Epiphyte, on trunks or on bases of *Aglaomorpha*, or on earth banks. Altitude c. 1200 m.

Note — Fresh fronds have a bluish green bloom (*Molesworth Allen 1710*).

DRYNARIA

(P. H. Hovenkamp & M. C. Roos)

Drynaria J. Sm., J. Bot. (Hook.) 3 (1841) 397, nom. cons.; Fée, Gen. Filic. (1850–1852) 269; Bedd., Ferns S. India (1863) 63; J. Sm., Ferns Brit. & For. (1866) 102; Hist. Fil. (1875) 107; Bedd., Handb. Ferns Brit. India (1883) 338; Diels, Bot. Jahrb. Syst. 29 (1900) 207; Copel., Polypod. Philipp. (1905) 135; Alderw., Malayan Ferns (1908) 696; Copel., Philipp. J. Sc., Bot. 6 (1911) 140; Alderw., Malayan Ferns Suppl. (1917) 415; Copel., Univ. Calif. Publ. Bot. 16

(1929) 117; Backer & Posth., Varenfl. Java (1939) 232; Ching, Sunyatsenia 5 (1940) 261; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 516; Copel., Gen. Fil. (1947) 203; Holttum, Revis. Fl. Malaya 2 (1954) 182; Copel., Fern Fl. Philipp. (1960) 496; Tind., Contr. NSW Nat. Herb., Flora ser. 208-211 (1961) 29; Brownlie in Fl. Nouv. Caléd. et Dép. 3 (1969) 278; Morton, Taxon 19 (1970) 647; Pichi Serm., Webbia 31 (1977) 379; Roos, Drynarioideae (1985) 255; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 212. — *Polypodium* subg. *Drynaria* Bory, Ann. Sci. Nat. 5 (1825) 464; Hook., Gard. Ferns (1862) pl. 1; Sp. Fil. 5 (1864) 93; Baker, Syn. Fil. (1868) 366. — *Phymatodes* # *Drynaria* C. Presl, Tent. Pterid. (1836) 197; Hook. & Bauer, Gen. Fil. (1842) t. 21. — *Drynaria* *** *Drynaria* J. Sm., J. Bot. (Hook.) 4 (1842) 61. — *Drynaria* sect. *Eudrynaria* Fée, Gen. Filic. (1850-1852) 170, nom. inval.; Alderw., Malayan Ferns (1908) 697; Suppl. (1917) 415. — Type species: *Drynaria quercifolia* (L.) J. Sm.

Drynaria # *Poronema* J. Sm., Hist. Fil. (1875) 108; Alderw., Malayan Ferns (1908) 679; Suppl. (1917) 415; Copel., Gen. Fil. (1947) 204. — Type species: *Drynaria diversifolium* (R. Br.) J. Sm. (= *Drynaria rigidula*).

Epiphytic, epilithic or terrestrial. *Rhizome* up to 3 cm thick, sometimes more, short- or long-creeping, internodia up to 18 cm long, fronds not on elevated phyllopodia. Anatomy: vascular bundles 15 to many (50–100), in cross section arranged in 1 or 2 flattened circles with a dorsal protrusion; sclerenchyma strands absent or present. *Rhizome scales* appressed or, often squarrosely, spreading, basifixed or peltate, monomorphic, or dimorphic, with elongated and short, round scales, margin toothed. *Fronds* monomorphic or usually dimorphic, with base and foliage fronds. Base fronds sessile, rounded to ovate-elliptical, entire to lobed up to 2/3. Foliage fronds internally monomorphic or with slightly narrowed fertile parts, stalked, pinnatifid or sometimes pinnate, with conspicuous nectaries situated above the junctions of rachis and costae, or of costae and veins, hairs sometimes present, spread over the lamina. Pinnae articulated to the rachis, deciduous, rachises often persistent. *Venation* highly complex, with main areoles delimited by the veins and connecting veins, filled with numerous small areoles containing excurrent and recurrent free veinlets, sometimes terminating in a hydathode. Fertile parts similar to sterile or slightly narrowed, sori small, in rows along veins or connecting veins. Sporangia glabrous or sometimes with glandular hairs. Spores with spines or small globules. — **Fig. 6.**

Distribution — Paleotropical. Throughout *Malesia*.

Note — When the base fronds disintegrate, some species retain the naked rachises for a long time, sometimes with an empty mesh of finer veins.

Taxonomy — *Drynaria* is a distinct genus, best recognisable by the peculiar frond dimorphism between sterile base fronds and fertile foliage fronds, the distinctive leathery texture of the lamina, a distinctive venation pattern and the presence of nectaries near the bases of the pinnae. The last three characters are shared with *Aglaomorpha*. A curious character unique to *Drynaria* is the aborted apex, with a lateral pinna taking its place, giving a peculiar 'lop-sided' look to the apical part of most fronds.

Together with *Aglaomorpha*, *Drynaria* forms a distinct group, recognised as subfamily *Drynarioideae* by Crabbe, Jermy & Thomas (Fern Gaz., 1975), and as tribe *Drynarieae* by Hennipman et al. (1990). Roos (1985) presents a cladistic analysis but does not propose a subdivision of *Drynaria* based on his analysis.

KEY TO THE SPECIES

- 1a. Sori in a single row between the veins, rhizome with sclerenchyma strands . . 2
- b. Sori in two or more rows between the veins, rhizome without sclerenchyma strands 3
- 2a. Foliage fronds pinnatifid **4. D. pleuridioides**
- b. Foliage fronds pinnate **6. D. rigidula**
- 3a. Rhizome scales spreading, without midrib in the acumen **5. D. quercifolia**
- b. Rhizome scales appressed or with a narrow, squarrose acumen with a distinct midrib 4
- 4a. Base fronds margin sinuate to distinctly lobed **7. D. sparsisora**
- b. Base fronds entire to shallowly sinuate 5
- 5a. Foliage pinnae without basal constriction, 1–2.5 cm wide, apex obtuse to acute **2. D. descensa**
- b. Foliage pinnae with a basal constriction, 2.5–4 cm wide, apex acute to acuminate 6
- 6a. Base fronds overlapping, completely covering the rhizome, rhizome to 3 cm thick, thickened midrib in the acumen of the rhizome scales brown, free veinlets simple or absent **1. D. bonii**
- b. Base fronds spaced, usually not completely covering the rhizome, rhizome to 1 cm thick, midrib in the acumen of the rhizome scales black, free veinlets simple or forked **3. D. involuta**

1. *Drynaria bonii* H. Christ

Drynaria bonii H. Christ, Not. Syst. 1 (1910) 186; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 517; Roos, Drynarioideae (1985) 261. — Type: *Bon 3204* (P), Tonkin.

Rhizome terete to dorsiventrally flattened, 0.3 cm thick, 1–2 cm wide, short-creeping, internodia up to 10 cm long. Anatomy: vascular bundles 15–30, equally sized, arranged in a single row, without dark bundle sheaths, sclerenchyma strands absent. *Rhizome scales* squarrose or spreading from an appressed base, peltate, dimorphic; the elongate scales 2–12 by 1.5–3 mm, index 1.5–6, acumen often subulate, suddenly contracted from a wide base, often with a distinct, brown midrib, margin irregularly and shortly dentate at base, nearly entire in the acumen. *Fronde* dimorphic, glabrous, rachises not or rarely persistent. Base fronds contiguous or overlapping, often completely covering and surrounding the rhizome, sessile, nearly entire to shallowly lobed, 4–8 by 3.5–7 cm, index 1–1.3. Foliage fronds stalked, stipe up to 15 cm long, conspicuously winged with a sinuose wing, lamina pinnatifid to 0.2–0.5 cm from costa, 17–25 by 12–17 cm, index 2–3, apex aborted. Pinnae with basal constriction, all equally long or the lowermost pinnae sometimes reduced, 7–10 by 1–2.5 cm, index 3–4, margin entire, apex obtuse, acute or acuminate, free veinlets simple or absent, hydathodes absent. *Sori* in 2 irregular rows parallel to the veins, often concentrated near the midrib and the margin, 2–4 in each main areole, round, 1–2 mm, slightly sunken. Sporangia glabrous. Spores with spines.

Distribution — India to China and Indochina. In *Malesia*: Penang Island, Langkawi Island.

Habitat — Epilithic or terrestrial, often epiphytic, spirally climbing; in various types of forests, up to 10 m above ground level; often on limestone rocks. Altitude at sea level.

2. *Drynaria descensa* Copel.

Drynaria descensa Copel., Philipp. J. Sc., Bot. 3 (1908) 36; Alderw., Malayan Ferns (1908) 698; Copel., Univ. Calif. Publ. Bot. 16 (1929) 119; Fern Fl. Philipp. (1960) 497; Roos, Drynarioideae (1985) 264; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 150. — Type: *Copeland 2061* (PPE 42) (B, BM, G, K, L, NSW, NY, S), Philippines, Luzon.

Rhizome 1–3 cm thick, short-creeping, internodes up to 10 cm long. Anatomy: vascular bundles 20–30, equally sized, arranged in one row, without dark bundle sheaths, sclerenchyma strands absent. *Rhizome scales* squarrosely spreading, peltate, dimorphic, the elongated ones 1–6 by 1–2 mm, index 1–5, apex acute (rarely acuminate) to rounded, midrib present. *Fronds* dimorphic, glabrous, rachises not or rarely persistent. Base fronds contiguous, mostly overlapping, nearly entire to shallowly lobed, 5–10 by 4–9 cm, index 1–1.4. Foliage fronds stalked, stipe 5–15 cm long, conspicuously winged, lamina pinnatifid to 0.2–0.5 cm from costa, 30–70 by 12–25(–30) cm, index 2–3.5, apex aborted. Pinnae without or with a weak basal constriction, all equally long, 8–21 by 1–2.5 cm, index 5–12, margin entire, apex obtuse to acute-acuminate, free veinlets absent, simple or once forked, hydathodes absent. *Sori* in 2 irregular rows parallel to the veins, 2 or 3 in each main areole, round, 1–2 mm, slightly sunken. Sporangia glabrous. Spores with spines.

Distribution — *Malesia*: Philippines (Luzon).

Habitat — Epiphytic, spirally climbing, often epilithic or terrestrial; in open forest, oil palm plantations. Altitude c. 1600 m.

3. *Drynaria involuta* Alderw.

Drynaria involuta Alderw., Bull. Dép. Agric. Ind. Néerl. 21 (1908) 8, t. 4; Malayan Ferns (1908) 700; Suppl. (1917) 415; Roos, Drynarioideae (1985) 263. — *Drynaria convoluta* Alderw., Bull. Jard. Bot. Buitenzorg II, 1 (1911) 6, nom. illeg. — Type: *Teijsmann 8577* (L), Borneo.

Rhizome dorsiventrally somewhat flattened, up to 1 cm wide, short-creeping, the internodes up to 10 cm long. Anatomy: vascular bundles 15–20, c. 4 dorsal strands enlarged, arranged in one row, with or without dark bundle sheaths, sclerenchyma strands absent. *Rhizome scales* peltate, monomorphic, usually from a wide appressed base contracted into a narrow, subulate, squarrose acumen, dimorphic, elongate scales 1–8 by 0.5–2 mm, index 1–4, apex subulate, deciduous, dentate, midrib usually present, black. *Fronds* dimorphic, rachises not or rarely persistent. Base fronds contiguous, mostly not widely overlapping, sessile, nearly entire to shallowly lobed, 5–10 by 4–8 cm, index 1–1.4. Foliage fronds stalked, stipe up to 20 cm long, inconspicuously winged, lamina glabrous, pinnatifid to within 0.2 cm from costa, 20–45 by 12–25 cm, index 2–3, apex aborted. Pinnae with basal constriction, all equally long, 7–15 by 2.5–4.5 cm, index 3–4, margin entire, apex acute, acuminate to caudate, free veinlets simple or once forked, hydathodes absent. *Sori* in 2 irregular rows parallel to the veins, 1–2(–3) in each main areole, round, 1–2 mm, slightly sunken. Sporangia glabrous. Spores with spines.

Distribution — *Malesia*: Borneo.

Habitat — Epiphytic, spirally climbing; in peat swamp forest, at 1–5 m above ground level. Altitude sea level.

4. *Drynaria pleuridioides* (Mett.) Diels

Drynaria pleuridioides (Mett.) Diels in Engl. & Prantl, Nat. Pflanzenfam. I, 4 (1899) 330; Alderw., Malayan Ferns (1908) 697; Suppl. (1917) 415; Backer & Posth., Varenfl. Java (1939) 234; Tagawa, Acta Phytotax. Geobot. 25 (1973) 96; Roos, Drynarioideae (1985) 272. — *Polypodium pleuridioides* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 230; Baker in Hook. & Baker, Syn. Fil. (1868) 367; Salomon, Nomenclator (1883) 314; Racib., Pterid. Buitenzorg (1898) 117. — Type: *Blume s.n.* (L), Java.

Drynaria pleuridioides var. *amboinensis* Alderw., Malayan Ferns (1908) 697. — Type: *Boerlage s.n.* (L), Moluccas.

Drynaria propinqua var. *sumatrana* Alderw., Malayan Ferns (1908) 698. — Type: *Anonymous* (n.v.), Sumatra.

Polypodium willdenowii auct. non Bory p.p.: *Blume*, Fl. Javae Fil. (1829) 156, pl. 66.

Rhizome 1–2 cm thick, short-creeping, internodes up to 10 cm long. Anatomy: vascular bundles 20–30, c. 4 dorsal strands enlarged, arranged in one row, without dark bundle sheaths, peripheral or central sclerenchyma strands present. *Rhizome scales* spreading, peltate, monomorphic, 4–8 by 0.7–1.2 mm, index 6–11, apex narrowly acuminate to short-filiform, strongly dentate to short curly-ciliate, midrib absent. *Fronds* dimorphic, rachises persistent. Base fronds overlapping, contiguous or separate, lobed (sometimes deeply), 10–30 by 7–18(–22) cm, index 1.3–1.7, margin irregularly denticulate. Foliage fronds often slightly internally dimorphic, glabrous, stalked, stipe 10–25 cm long, conspicuously winged, lamina pinnatifid to within 0.5 cm from costa, 40–100 by 20–40 cm, index 2–5, apex aborted or sometimes apical pinna present. Pinnae without basal constriction, gradually smaller towards the apex, 12–25 by (1–)2–3.5 cm, index 6–8, margin entire, apex obtuse to acute, free veinlets simple or forked several times, hydathodes often present. *Sori* costal, in one row between costa and margin, singly between the veins, round, 2–3 mm, distinctly sunken. Sporangia glabrous. Spores verrucate, without spines or small globules. — **Fig. 6c.**

Distribution — *Malesia*: Sumatra, Java, Lesser Sunda Islands, Sulawesi, Moluccas (Ambon?).

Habitat — Epiphytic, encircling the trunk many times, or spirally climbing; in primary and secondary forest, occasionally in plantations. Altitude (50–)550–1400 (–1550) m.

Uses — Roots used as substitute for Betel. Leaves placed on a bamboo pole near *Areca* trees are supposed to curse thieves with insanity (Alor).

5. *Drynaria quercifolia* (L.) J. Sm.

Drynaria quercifolia (L.) J. Sm., J. Bot. (Hook.) 3 (1841) 398; Fée, Gen. Filic. (1850–1852) 271; Bedd., Ferns S. India (1863) 63, pl. 187; J. Sm., Hist. Fil. (1875) 108; Suppl. Ferns S. Ind. & Brit. India (1876) 24; Handb. Ferns Brit. India (1883) 343, f. 191; Copel., Polypod. Philipp. (1905) 135; Alderw., Malayan Ferns (1908) 698; Copel., Philipp. J. Sc., Bot. 6 (1911) 91; Alderw., Malayan Ferns Suppl. (1917) 415; Brause, Bot. Jahrb. Syst. 56 (1920) 208; Copel., Univ. Calif. Publ. Bot. 16 (1929) 119; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 518;

- Copel., Gen. Fil. (1947) 204; Holttum, Revis. Fl. Malaya 2 (1954) 182; Copel., Fern Fl. Philipp. (1960) 496; Sledge, Bull. Br. Mus. (Nat. Hist) Bot. 2 (1960) 144; Roos, Drynarioideae (1985) 258; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 28. — *Polypodium quercifolium* L., Sp. Pl. (1753) 1087; Blume, Enum. Pl. Javae (1828) 135; Fl. Javae Fil. (1829) 153 (58); Hook., Sp. Fil. 5 (1864) 96; Baker in Hook. & Baker, Syn. Fil. (1868) 367; Cesati, Atti Accad. Sci. Fis. 7 (1876) 28; Becc., Malesia 2 (1884) 246; 3 (1886) 25; Racib., Pterid. Buitenzorg (1898) 118. — *Phymatodes quercifolia* C. Presl, Tent. Pterid. (1836) 198; Hook. & Bauer, Gen. Fil. (1842) t. 21. — Type: *Herb. Hermann I*: 39 (BM).
- Polypodium sylvaticum* Schkuhr, Kr. Gew. 1 (1809) 22, pl. 8b. — *Phymatodes sylvatica* C. Presl, Tent. Pterid. (1836) 198. — Type: Schkuhr, l.c.: pl. 8b.
- Polypodium schkuhrii* Bory, Ann. Sci. Nat. 5 (1825) 467. — Type: Schkuhr, Kr. Gew. 1 (1809) pl. 13.
- Polypodium morbillosum* C. Presl, Reliq. Haenk. (1825) 22, t. 3, f. 3; 37, t. 20, f. 9; Mett., Fil. Hort. Bot. Lips. (1856) 37, t. 20, f. 9; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 21. — *Phymatodes morbillosa* C. Presl, Tent. Pterid. (1836) 198. — *Drynaria morbillosa* J. Sm., J. Bot. (Hook.) 3 (1841) 398, p.p. — Type: *Haenke s.n.* (PRC: Herb. C. Presl).
- Polypodium brancaefolium* C. Presl, Reliq. Haenk. (1825) 22; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 19. — *Phymatodes brancaefolia* C. Presl, Tent. Pterid. (1836) 198. — Type: *Haenke s.n.* (PRC: Herb. C. Presl).

Rhizome 2–3 cm thick or more, short-creeping, internodes up to 10 cm long. Anatomy: vascular bundles many, equally sized, arranged in 1 or 2 rows, without dark bundle sheaths, sclerenchyma strands absent. *Rhizome scales* brown-blackish, spread-

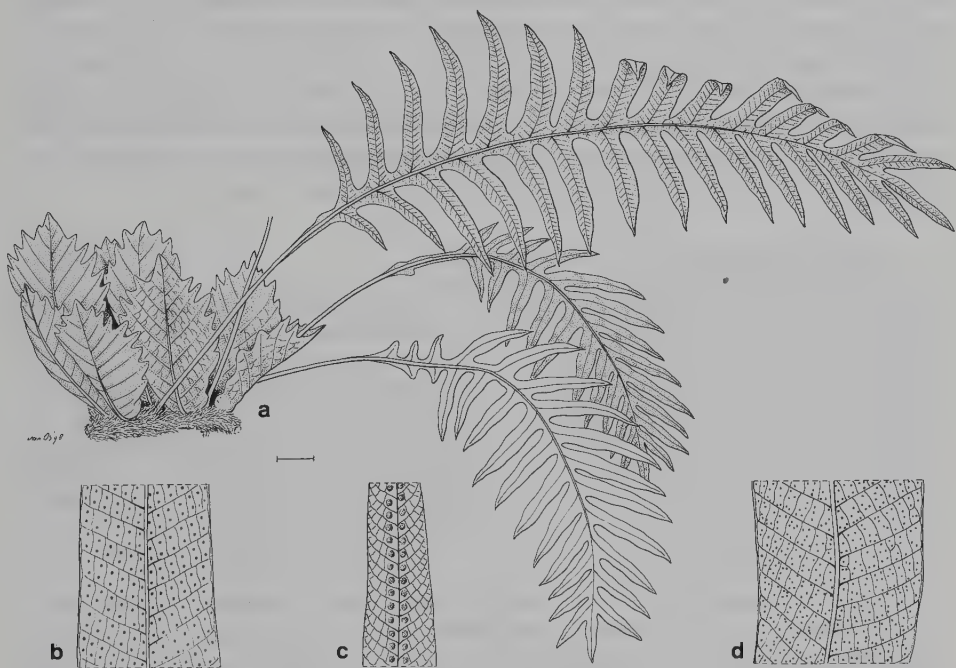


Fig. 6. *Drynaria quercifolia* (L.) J. Sm. a. Habit; b. fertile parts. — *D. pleuridioides* (Mett.) Diels. c. Fertile parts. — *D. sparsisora* (Desv.) T. Moore. d. Fertile parts (a: cultivated specimen in Leiden Botanical Garden; b: PNH 41971; c: Alston 12957; d: Hennipman 5707). — Scale bar: a = 5 cm, b–d = 1 cm. Drawings by J.H. van Os.

ing, pseudopeltate or peltate, monomorphic, 6–20 by 0.5–1 mm, index 10 to linear, towards the apex strongly dentate, apex long, narrow, acute (rarely acuminate), midrib mostly absent. *Fronds* dimorphic, rachises persistent. Base fronds contiguous or separate, sessile, shallowly lobed, (10–)15–50 by 10–30(–40) cm, index 1–1.4, margin entire. Foliage fronds stalked, stipe up to 15–30(–35) cm long, not or inconspicuously winged, lamina pinnatifid to 0.2–0.5 cm from costa, 40–100(–150) by 15–50 cm, index 2.5–4, apex aborted. Pinnae without a basal constriction, all equally long, 1–25(–30) by 2–4.5 cm, index 4–6, margin entire, apex acute, free veinlets infrequent, simple or absent, hydathodes absent. *Sori* in two regular (sometimes irregular) rows parallel and close to the veins, round, 1–2 mm, slightly sunken. Sporangia glabrous. Spores with spines. — **Fig. 6a, b.**

Distribution — Southeast Asia to Australia. Throughout *Malesia*.

Habitat — Epiphytic, spirally climbing, occasionally epilithic, or terrestrial, at 1–10 m or more above ground level; in various types of primary and secondary forest, plantations (rubber, coconut, djati, arèn), savannahs. Altitude from sea level to 1200(–1900) m.

Uses — Grown as ornamental. Medicine for stomach ache (Philippines); ‘obat kapala sakit’, marrow from the rhizome mixed with santen is applied to the head against headache (Sumba: Kanangan).

Notes — 1. Can be confused with *D. sparsisora*, which is usually easily distinguished by the appressed scales with squarrose, narrow acumen and the more irregularly scattered sori. Specimens without rhizome, however, cannot always be identified with certainty.

2. The scales vary from brown, concolorous to blackish, with a more or less flabelloid margin near the base, and a more or less distinct midrib running through the acumen. This latter type is most frequent in plants from West Malesia (Sumatra, Java). In all cases the margin is strongly dentate, with long, straight teeth.

6. *Drynaria rigidula* Bedd.

Drynaria rigidula Bedd., Ferns Brit. India (1869) t. 314; Suppl. Ferns S. Ind. & Brit. India (1876) 24; Handb. Ferns Brit. India (1883) 344, f. 192; Copel., Polypod. Philipp. (1905) 135; Alderw., Malayan Ferns (1908) 699; Suppl. (1917) 415; Backer & Posth., Varenfl. Java (1939) 233, f. 14; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 421; Copel., Gen. Fil. (1947) 204; Holtum, Revis. Fl. Malaya 2 (1954) 183; Copel., Fern Fl. Philipp. (1960) 497; Brownlie in Fl. Nouv. Caléd. et Dép. 3 (1969) 79, pl. 37, f. 2, 3; Pterid. Fl. Fiji (1977) 363; Roos, Drynarioideae (1985) 274. — *Polypodium rigidulum* Sw., J. Bot. (Schrader) 1800 (2) (1801) 26; Baker in Hook. & Baker, Syn. Fil. (1868) 368; Racib., Pterid. Buitenzorg (1898) 117. — *Goniophlebium rigidulum* T. Moore, Index Filic. II (1862) 396. — Type: *Thunberg* (S), Java.

Polypodium gaudichaudii Bory, Ann. Sci. Nat. 5 (1825) 471, t. 14; Blume, Enum. Pl. Javae (1828) add.; Fl. Javae Fil. (1829) 158; Mett., Farngatt. I. Polypodium (1856) 120, t. 3: 46–47. — *Drynaria gaudichaudii* Gaudich. in Freycin., Voy. Bot. (1826) 355, nom. inval. — *Phymatodes gaudichaudii* C. Presl, Tent. Pterid. (1836) 198. — Type: *Gaudichaud s.n.* (P), Java.

[*Polypodium glaucistipes* Wall., Cat. (1828) 298, nom. nud.]

Drynaria pinnata Fée, Gen. Filic. (1850–1852) 272. — Type: *Cuming* 263 (B, BM, K, L, W), Philippines, Luzon.

Polypodium speciosum Blume, Enum. Pl. Javae (1828) 132. — Type: *Blume s.n.* (L; iso B), Java.

Drynaria rigidula var. *koordersii* Alderw., Bull. Jard. Bot. Buitenzorg II, 1 (1911) 6. — Type: *Koorders* 24098 B (L), Java.

Rhizome 1–2 cm thick, short-creeping, internodes up to 2.5 cm long. Anatomy: vascular bundles 15–30 with c. 4 enlarged dorsal strands, in one row, without dark bundle sheaths, sclerenchyma strands present, central or peripheral. *Rhizome scales* brown to dark brown, with a lighter margin, spreading, peltate, monomorphic, 5–13 by 0.5–1.5 mm, index 4 to linear, apex acute to acuminate, the margin ciliate with fine, straight or somewhat curly cilia, midrib absent or indistinct. *Fronds* dimorphic, rachises persistent. Base fronds spreading, mostly overlapping, lobed up to 4/5, 10–30 by 5–15 cm, index 1.5–3.5, margin irregularly and finely denticulate. Foliage fronds stalked, stipe to 40 cm long, not winged, with two rows of nectaries, lamina pinnate, 25–100(–200) by 12–50 cm, index 2–4(–6), apex aborted. Pinnae all equally long or smaller towards the apex, 8–25(–30) by 0.5–3 cm, index 6 to linear, base narrowly cuneate, margin crenate to serrate, apex obtuse to acuminate, free veinlets simple or absent, hydathodes absent. *Sori* in one row between costa and margin, costal, singly between the veins, round, 1–2 mm, sunken. Sporangia glabrous. Spores with spines.

Distribution — Southeast Asia to the Pacific and Australia. Throughout *Malesia*, but absent from the Lesser Sunda Islands.

Habitat — Epiphytic, encircling the trunk many times, occasionally terrestrial, then forming a crust; in various types of primary and secondary forest, savannah and plantations (coconut, oilpalm, rubber), roadside trees. Also epilithic, on lava or limestone, exposed. Altitude from sea level to 2000(–2400) m.

Notes — 1. Juvenile fronds may be variously intermediate between base and foliage fronds. In older plants, base fronds may be absent. Young fronds are covered with down which is often retained on the base fronds until they are quite old and withered, and often also on the stipe and rachis of foliage fronds.

2. Probably quite frequently harbouring ants.

7. *Drynaria sparsisora* (Desv.) T. Moore

Drynaria sparsisora (Desv.) T. Moore, Index Filic. II (1862) 348; C. Chr., Ind. Fil. (1906) 249; Alderw., Malayan Ferns (1908) 699; Copel., Philipp. J. Sc., Bot. 6 (1911) 91; Brause, Bot. Jahrb. Syst. 56 (1920) 208; Alderw., Nova Guinea 14 (1924) 15; Copel., Univ. Calif. Publ. Bot. 16 (1929) 119; C. Chr. & Holttum, Gard. Bull. Str. Settlm. 7 (1934) 315; Copel., Gen. Fil. (1947) 204; Holttum, Revis. Fl. Malaya 2 (1954) 183; Copel., Fern Fl. Philipp. (1961) 497; Roos, Drynarioideae (1985) 256. — *Polypodium sparsisorum* Desv., Mag. Ges. Naturf. Freunde Berlin (Berl. Mag.) 5 (1811) 315; Mém. Soc. Linn. Paris 6 (1827) 235. — Type: not traced.

Polypodium linnei Bory, Ann. Sci. Nat. 5 (1825) 464, p.p., t. 12; Baker in Hook. & Baker, Syn. Fil. (1868) 368; Racib., Pterid. Buitenzorg (1898) 118. — *Drynaria linnei* Bedd., Ferns Brit. India (1869) t. 315; Handb. Ferns Brit. India (1883) 343; Copel., Polypod. Philipp. (1905) 135. — Type: *Gaudichaud s.n.* (P, n.v.), Java.

Rhizome 1–3 cm thick or more, short-creeping, phylloids up to 10 cm distant. Anatomy: vascular bundles many, equally sized, arranged in 1 or 2 rows, without dark bundle sheaths, sclerenchyma strands absent. *Rhizome scales* peltate, monomorphic, with appressed base and squarrosely spreading acumen, dark brown-blackish with a lighter lacerate margin, strongly dentate to short-ciliate, elongated, 1.5–11 by 1–2.5 mm, index 1–8.5, apex acute, midrib present. *Fronds* dimorphic, rachises not persistent. Base fronds sessile, contiguous, mostly imbricate, lobed to 1/3, (10–)

15–35 by (10–)15–25 cm, index 1–1.5, margin entire, apex rounded. Foliage fronds stalked, stipe (5–)10–18 cm long, conspicuously winged, lamina pinnatifid to 0.2–0.5 cm from costa, 30–80 by 15–30 cm, index 2–4, apex aborted. Pinnae with or without basal constriction, all equally long, to 10–20 by 1.5–3.5 cm, index 3.5–6(–8), margin entire, apex acute to caudate, free veinlets simple or absent, hydathodes absent. *Sori* 2–7 in each areole irregularly scattered or in two irregular rows between the connecting veins, round, 1–2 mm wide, slightly sunken, often distinctly pustulate on the upper surface. Sporangia glabrous. Spores with spines. — **Fig. 6d.**

Distribution — Southeast Asia to Australia. Throughout *Malesia*, but not known from the Lesser Sunda Islands.

Habitat — Epiphytic, spirally climbing, sometimes terrestrial, up to 35 m above ground level; in various types of primary and secondary forest, also savannah. Also terrestrial on sandy soil and epilithic, on volcanic rocks. Altitude from sea level to 1400(–1700) m.

Note — Juvenile foliage fronds often have a somewhat dilated frond base. The narrow, needle-like acumen of the rhizome scales often disappears from old scales, leaving older parts of the rhizome completely covered by characteristic, short, dark, appressed scales and scale-bases. Juvenile specimens tend to have longer, more narrowly subulate acumens, which also appear to be absent from older parts. Although the scales are usually quite different from those of *D. quercifolia*, occasionally some more intermediate forms occur. Juvenile plants or specimens without rhizome may be impossible to identify with certainty.

Uses — Medicine for eyes; rhizome applied to snake bites (Philippines), used for ‘rat scare-crow’ (Philippines). Salakans use it to be invisible to evil ghosts inhabiting *Ficus* species. Children use the base fronds as kites (Java).

GONIOPHLEBIUM

(P. H. Hovenkamp & G. Rödl-Linder)

Goniophlebium C. Presl, Tent. Pterid. (1836) 185; Bedd., Ferns Brit. India (1866) 163, 206; Handb. Ferns Brit. India (1883) 316; Fée, Gen. Filic. (1850–1852) 254; Copel., Univ. Calif. Publ. Bot. 16 (1929) 109; Gen. Fil. (1947) 181; Farwell, Amer. Midl. Nat. 12 (1931) 295; Zijlstra et al., Taxon 36 (1987) 759; Rödl-Linder, Blumea 34 (1990) 371; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 225 (*‘Goniophlebium Group’*). — *Polypodium* sect. *Goniophlebium* Blume, Fl. Java Fil. (1829) 132. — *Polypodium* subg. *Goniophlebium* C. Chr., Contr. U.S. Nat. Herb. 26 (1931) 315. — Type species: *Goniophlebium subauriculatum* (Blume) C. Presl.

Schellolepis J. Sm., Ferns Brit. & For. (1866) 82; Hist. Fil. (1875) 92; Pichi Serm., Webbia 28 (1973) 468. — *Goniophlebium* sect. *Schellolepis* J. Sm., J. Bot. (Hook.) 4 (1842) 56. — Type species: *Schellolepis percussa* (Cav.) Pichi Serm. (= *Goniophlebium percussum*).

Epiphytic or epilithic, occasionally terrestrial. *Rhizome* long-creeping, phylloids 0.5–5 cm distant. Anatomy: ground tissue parenchymatous, sclerenchyma strands present. *Rhizome scales* basifixed to pseudopeltate, entirely or mostly clathrate, appressed to erect, margin dentate, apex acuminate to filiform, often with superficial hairs. *Fronds* monomorphic, stipitate, pinnate to pinnatifid, margin crenate to serrate. *Venation* with 1–several rows of areoles each with 1 included, excurrent, free veinlet;

marginal row of excurrent veinlets present. Hydathodes present. *Sori* round, in 1–3 rows between pinna-midrib and margin, superficial to deeply sunken. Scaly paraphyses present, long-stalked, with basifixed or peltate, clathrate blade. — **Fig. 7, 8.**

Distribution — Northern India to Japan, Samoa, Australia (Queensland). Throughout *Malesia*.

Taxonomy — *Goniophlebium* has been regarded as a part of *Polypodium*, closely allied to a number of pinnate species from the Neotropics. Several authors considering *Goniophlebium* distinct from *Polypodium* have included the Neotropic as well as the Asian species. However, Copeland (e.g., 1929, 1947) pointed out that the Asian and American lines in this group should be considered distinct, and circumscribed the Asian *Goniophlebium* species by the separate, articulate pinnae. In this he was not widely followed, and many authors continued to use the name *Polypodium* for the Asian representatives. Copeland's (l.c.) distinction is followed here, but *Goniophlebium* is distinguished by a combination of characters (see also Rödl-Linder 1990): rhizome with sclerenchyma strands, rhizome scales pseudopeltate, clathrate, lamina pinnate or pinnatifid, venation simple, with at most one, excurrent included vein in each areole.

Within *Goniophlebium*, Rödl-Linder distinguished five groups. The *G. percussum*-group is diagnosed by having all pinnae articulated. This group comprises all Malaysian species except *G. mengtzeense*, *G. prainii*, *G. pseudoconnatum* and *G. subauriculatum*. The other groups are not clearly diagnosed. *Goniophlebium pseudoconnatum* and *G. subauriculatum* are placed close together, with a number of mainly Asian species, of which *G. prainii* occupies a somewhat uncertain, basal position in the group. *Goniophlebium mengtzeense* is considered most closely related to the Asian *G. argutum*.

KEY TO THE SPECIES

- 1a. All pinnae broadly adnate **11. *G. prainii***
- b. At least the lower half of the frond fully pinnate, with articulate pinnae 2
- 2a. Rhizome scales with an appressed base, rhizome green, turning brown when dry 3
- b. Rhizome scales erect, rhizome glaucous or white-waxy beneath the scales .. 11
- 3a. Venation with a single row of areoles, a second irregular row composed of scattered areoles without included veinlets sometimes present 4
- b. Venation with 2 or 3 rows of areoles, at least 2 rows with included veinlets .. 8
- 4a. Basal cells of rhizome scales not clathrate 5
- b. Basal cells of rhizome scales clathrate 6
- 5a. Large plants; stipe 3–5 mm thick at the base, lamina over 40 cm, widest above the base, rhizome scales gradually contracted into a wide, strongly dentate acumen (20 or more cells wide at the base) **2. *G. demersum***
- b. Small plants; stipe less than 2 mm thick at the base, lamina less than 20 cm long, widest at the base, rhizome scales rather suddenly contracted into a narrow, shortly dentate acumen (12 cells wide or less) **10. *G. terrestre***
- 6a. *Sori* deeply sunken **4. *G. mehipitense***
- b. *Sori* superficial or slightly sunken 7

- 7a. Terminal segment 2/3 as long as or longer than longest lateral pinna, vascular strands without dark sheaths **1. *G. benguense***
 b. Terminal segment about half as long as longest lateral pinna, vascular strands with dark sheaths **9. *G. serratifolium***
 8a. Rhizome dorsiventrally flattened, in cross section with less than 20 sclerenchyma strands 9
 b. Rhizome terete, in cross section with over 40 sclerenchyma strands 10
 9a. Sori uni- to triserial, lamina less than $1.2 \times$ as long as wide, spores with very long polar excrescences **3. *G. korthalsii***
 b. Sori uniserial, lamina $1.5 \times$ as long as wide or longer, spores with short polar excrescences **8. *G. rajaense***
 10a. Sori small, less than 1 mm wide, deeply sunken, surrounded by a ring of dark paraphyses **6. *G. percussum***
 b. Sori larger, c. 2 mm wide, slightly sunken, without ring of dark paraphyses ...
 **7. *G. persicifolium***
 11a. Sori superficial, small rhizome scales abundant **5. *G. mengtzeense***
 b. Sori slightly sunken, small rhizome scales not abundant 12
 12a. Rhizome scales dull dark brown, with a relatively wide acumen, apex not filiform, superficial hairs absent; fronds dark green with firm stipe and rachis (living plants), rhizome with many (30–50) sclerenchyma strands, sori 1.5–2 mm wide, sporangia sometimes bearing acicular hairs .. **12. *G. pseudoconnatum***
 b. Rhizome scales light brown, with a narrow acumen and filiform apex, often with superficial hairs; fronds light green with very flexible stipe and rachis (living plants), rhizome with very many (100 or more) sclerenchyma strands, sori 1–1.5 mm wide, sporangia glabrous **13. *G. subauriculatum***

1. *Goniophlebium benguense* (Copel.) Copel.

Goniophlebium benguense (Copel.) Copel., Fern Fl. Philipp. (1960) 461; Rödl-Linder, Philipp. J. Sc. 116 (1987) 153, 154. — *Polypodium benguense* Copel., Philipp. J. Sc. 1, Suppl. (1906) 256, 257. — *Schellolepis benguensis* Pichi Serm., Webbia 28 (1973) 470; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 158 (*'Schellopis'*). — Type: *Copeland 1829* (*'1892'*) (MICH; iso P, B), Philippines, Luzon.

Polypodium mengtzeense auct. non H. Christ: Copel., Philipp. J. Sc. 1, Suppl. (1906) 161, pl. 21.

Rhizome terete, 2–3 mm thick, brown; phylloids 0.5–3 cm or more distant. *Anatomy*: vascular strands 7–10, without dark bundle sheaths, sclerenchyma strands very many (> 100). *Rhizome scales* inserted evenly, persistent, densely set, spreading, pseudopeltate, monomorphic, deltoid, 1.5–2 by 0.4–0.7 mm, index 2.5–2.9, basal auricles rounded to pointed, margin set with glands throughout, dentate, teeth gradually shorter towards the apex, apex filiform, cell walls clathrate throughout, cells relatively wide, 6–10 in a row between the margins at the base of the acumen, superficial hairs absent, rarely a tuft of hairs present near the point of attachment. *Fronds* pinnate, stipe 1.5–2.5 mm thick, 0.6–0.9 \times as long as the lamina, glabrous; lamina 12–39 by 8–20 cm, index 1.5–2, widest at or below the middle; pinnae articulate, sessile to shortly petiolate, 7–10 by 0.7–1 cm, index 6.7–10, widest in the basal 1/3, base truncate, margin deeply serrate, apex very narrowly acute to acuminate; basal

pair 1.2–2.5 cm distant from next pair, sometimes shorter and deflexed, apical segment conform or sometimes distinctly lobed at the base, 2/3 as long as to slightly longer than the largest pinnae. *Venation*: areoles uniserial, marginal veinlets 1–3 per areole, half as long as the areole, simple, irregularly anastomosing into areoles without included veinlets. Indument: 2-celled glandular hairs present, acicular hairs absent or sparse, 2–8 cells long, scales deciduous. *Sori* uniserial, medial, more or less sunken, 0.8–1.1 mm diam., receptacular scaly paraphyses persistent, clathrate, 120–170 by 100–140 μm , 2 or more cells wide. Sporangia glabrous. Spores yellow, cristate, with short polar excrescences.

Distribution — *Malesia*: Philippines (Luzon).

Habitat — Terrestrial or sometimes epiphytic; in secondary forest, mostly on mossy ground, sometimes epiphytic on pine trees, shaded, rarely exposed. Altitude 500–1500 m.

Note — Plants from exposed situations are smaller, with a firmer texture, a less strongly serrate margin, and more deeply sunken sori.

2. *Goniophlebium demersum* (Brause) Rödl-Linder

Goniophlebium demersum (Brause) Rödl-Linder, Blumea 34 (1990) 378. — *Polypodium demersum* Brause, Bot. Jahrb. Syst. (1912) 44. — Type: *Schultze* (33) 9 (B; BM, fragm.), New Guinea. *Goniophlebium subimpressum* Copel., Univ. Calif. Publ. Bot. 18 (1942) 226. — Type: *Clemens* 41222 (MICH).

Rhizome terete, 2–5 mm thick, brown; phyllopods 1–7 cm distant. Anatomy: vascular strands 7–10, with dark bundle sheaths, sclerenchyma strands many (60–90). *Rhizome scales* inserted evenly, persistent, densely set, spreading, pseudopeltate, monomorphic, deltoid, 2–5 by 1.3–2.6 mm, index 1.5–2, basal auricles rounded, margin at base sparsely set with glands, dentate but entire near the base, apex acuminate, cell walls not thickened at base of auricles, thinly clathrate in upper part, cells narrow, c. 20 in a row between the two margins at the base of the acumen, hyaline, a tuft of hairs usually present near the point of attachment. *Fronde* (pendent) pinnate, stipe 2–5 mm thick, 0.4–0.6 \times as long as the lamina, glabrous; lamina 40–70(–100) by 20–25 cm, index 2–2.8, widest at or below the middle; pinnae articulate, sessile, 11–19 by 0.5–1.5 cm, index 7.3–22, widest in the lower half, base cuneate to truncate, rarely cordate, margin serrate, apex very narrowly acute to acuminate; basal pair 2–3 cm distant from next pair, deflexed or not, apical segment conform, half to as long as longest pinnae, often lobed at the base. *Venation*: areoles uniserial, marginal veinlets very short or well-developed, rarely anastomosing into areoles which then lack included veinlets. Indument: 2- or 3-celled glandular hairs present, acicular hairs in varying density on veins and lamina, 2–6 cells long, scales persistent. *Sori* uniserial, marginal, slightly to deeply sunken, forming distinct papillae on the adaxial surface, 1.2–2.2 mm diam., receptacular scaly paraphyses deciduous, clathrate, 100–200 by 100–140 μm , 2 or more cells wide. Sporangia glabrous. Spores yellow, cristate, with short polar excrescences. — **Fig. 7e.**

Distribution — *Malesia*: Sulawesi (1 record), Moluccas (Seram), New Guinea; Solomon Islands.

Habitat — In rain forest, epiphytic on mossy or rotten tree trunks and branches, epilithic and terrestrial on mossy, wet ridges. Altitude 500–3000 m.

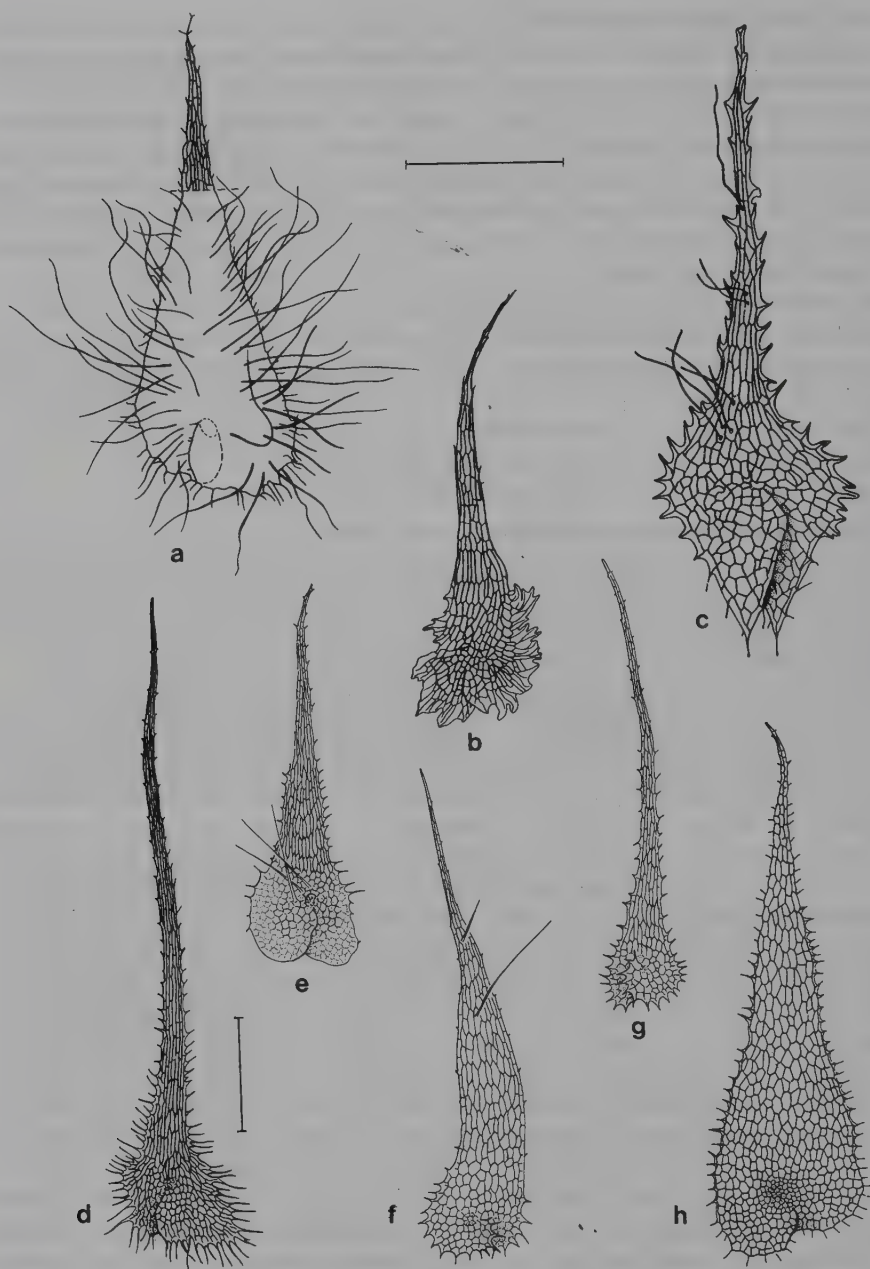


Fig. 7. *Goniophlebium*. Rhizome scales. — a. *G. persicifolium* (Desv.) Bedd. — b. *G. terrestre* Copel. — c. *G. percutsum* (Cav.) Wagner & Grether. — d. *G. korthalsii* (Mett.) Bedd. — e. *G. demersum* (Brause) Rödl-Linder. — f. *G. subauriculatum* (Blume) Presl. — g. *G. mehipitense* (C. Chr.) Parris. — h. *G. pseudoconnatum* (Copel.) Copel. (a–c: reproduced from Blume 34, 1990; d: Kato B 3729; e: Iwatsuki et al C 728; f: Rödl-Linder 147; g: Hallier 2107; h: Rödl-Linder 93). — Scale bars: a–c & d–h = 1 mm. Drawings (d–h) by J.H. van Os.

Notes — 1. *Goniophlebium demersum* has been confused with *G. tomentellum*, which is here included in *G. subauriculatum*.

2. Can be distinguished from *G. benguetense* by the larger rhizome scales, frequently with a tuft of hairs, the narrow cells in the acumen of the scale, the hyaline margin at the base of the auricles, the papillate sori, the infrequent anastomoses of the marginal veinlets.

3. *Goniophlebium korthalsii* (Mett.) Bedd.

Goniophlebium korthalsii (Mett.) Bedd., Suppl. Ferns Brit. India (1892) 91; Rödl-Linder, Blumea 34 (1990) 379. — *Polypodium korthalsii* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 223; Baker, Syn. Fil. (1867) 345; Holttum, Revis. Fl. Malaya 2 (1955) 204. — *Schellolepis korthalsii* Pichi Serm., Webbia 28 (1973) 470. — Type: *Korthals s.n.* (L; iso BO), Sumatra.

Rhizome dorsiventrally flattened, 3–4 by 2–3 mm, brown; phyllopoas 1.5–4.5 cm distant. Anatomy: vascular strands 9–12, with dark bundle sheaths, sclerenchyma strands few (4–8). *Rhizome scales* inserted evenly, deciduous, densely set, appressed to squarrosely spreading, pseudopeltate, monomorphic, deltoid, 1.7–4.9 mm, index 1.8–6.1, basal auricles short, rounded or pointed; margin at base sparsely set with glands, irregularly dentate, acumen dentate, apex filiform, not translucent, nearly completely filled with cell walls; cell walls clathrate, thicker towards apex, cells yellowish, superficial hairs absent or in a tuft near the point of attachment. *Fronas* pinnate, stipe 3–4 mm thick, 0.2–0.3 × as long as the lamina, glabrous; lamina 26–50 by 26–35 cm, index 1–1.5, widest at the base; pinnae articulate, sessile to shortly petiolate, 12.5–17.5 by 2.4–3.5 cm, index 5–5.2, base cuneate to angustate, margin crenate to serrate, apex acuminate; basal pair 2.5–4.5 cm distant from next pair and equally long, not deflexed, apical segment conform, equally long as longest pinnae or somewhat shorter. *Venation*: areoles 2- or 3-serial, marginal veinlets up to 1/3 as long as the areole, simple or forked, frequently anastomosing, forming areoles with or without included veinlets. Indument: 2-celled glandular hairs present, acicular hairs absent, scales deciduous or sometimes persistent. *Sori* 1–3-serial, superficial, 1.5–2 mm diam., receptacular scaly paraphyses persistent, clathrate, 76–140 by 76–153 µm, 2 or more cells wide. Sporangia glabrous. Spores yellowish, cristate with very long polar excrescences. — **Fig. 7d.**

Distribution — *Malesia*: Peninsular Malaysia (Perak), N Sumatra, Borneo (Kali-mantan Selatan, 1 coll.).

Habitat — Wet and swampy areas, epiphytic. Altitude 0–30(–800) m.

Note — A rare species, of which up to now only six collections are known.

4. *Goniophlebium mehipitense* (C. Chr.) Parris

Goniophlebium mehipitense (C. Chr.) Parris, Brit. Fern Gaz. 12 (1980) 118; Rödl-Linder, Blumea 34 (1990) 380. — *Polypodium mehipitense* C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 159. — Type: *H. Winkler 706* (HBG), Borneo.

Polypodium papilliferum Holttum, J. Mal. Br. Roy. As. Soc. 6 (1928) 22. — Type: *Boden Kloss 14800* (SING), Sumatra.

Rhizome terete, 5–6 mm thick, brown; phyllopoas 2–5 cm distant. Anatomy: vascular strands 11–13, with dark bundle sheaths, sclerenchyma strands very many (> 100).

Rhizome scales inserted evenly, deciduous, densely set, spreading, pseudopeltate, monomorphic, deltoid, 1.4–4.4 by 0.5–0.9 mm, index to c. 9, basal auricles rounded, margin without glands, dentate, teeth longer at base, apex acuminate to filiform, cell walls equally strongly clathrate throughout, cells yellowish, superficial hairs sometimes present. *Fronde* pinnate; stipe 2–4.5 mm thick, 0.3–0.5 × as long as the lamina, glabrous; lamina 26–69 by 11–23 cm, index 2.2–3.1, widest at or near the base; pinnae articulate, sessile, 6–13 by 1–1.8 cm, index 6–7.3, base truncate, margin serrate, apex obtuse to narrowly acute or acuminate; basal pair 3–4 cm distant from next pair and slightly shorter or equally long, not deflexed, apical segment conform, sometimes with two small separate auricles at base, half to almost as long as longest pinnae. *Venation*: areoles uni- to biserial, second row with or without included free veinlets, marginal veinlets up to 1/3 as long as the areole, simple or forked, occasionally anastomosing. Indument: 2-celled glandular hairs present, acicular hairs absent, scales deciduous or sometimes persistent. *Sori* uniserial, costal, deeply sunken, forming very distinct narrow, often caducous, papillae on upper surface, 0.4–0.5 mm diam., receptacular scaly paraphyses deciduous, clathrate, 100 by 65 µm, 2 cells wide. Sporangia glabrous. Spores brownish, cristate, with short polar excrescences. — **Fig. 7g.**

Distribution — *Malesia*: Sumatra, Borneo.

Habitat — Lowland to lower montane forest, low epiphyte or epilithic, on fallen logs, or on sandstone. Altitude 100–1000 m.

Note — Apparently a rare species.

5. *Goniophlebium mengtzeense* (H. Christ) Rödl-Linder

Goniophlebium mengtzeense (H. Christ) Rödl-Linder, Philipp. J. Sc. 116 (1987) 154; Blumea 34 (1990) 404. — *Polypodium mengtzeense* H. Christ, Bull. Herb. Boiss. 6 (1898) 869; Copel., Philipp. J. Sc. 1, Suppl. (1906) 256. — *Polypodium argutum* var. *mengtzeense* H. Christ, Bull. Acad. Int. Géogr. Bot. (1909) 177. — *Polypodiastrum mengtzeense* Ching, Acta Phytotax. Sin. 16 (1978) 28. — Type: *Henry 10964B* (P; iso K), Yunnan.

Polypodium subauriculatum auct. non Blume: Baker, Syn. Fil. (1867) 344.

Goniophlebium argutum auct. non J. Sm.: Copel., Fern Fl. Philipp. (1960) 462, p.p.

Rhizome terete, 3.5–5 mm thick, slightly glaucous to white-waxy; phyllopoas 1.5–6.5 cm distant. Anatomy: vascular strands 8–15, without dark bundle sheaths, sclerenchyma strands 40–90. *Rhizome scales* inserted evenly, blackish, densely set, dimorphic; large scales often caducous, erect, pseudopeltate, deltoid, 1.7–3.9 by 0.5–1.1 mm, index 3.4–3.6, basal auricles rounded, irregularly dentate, acumen contracted, apex filiform; margin densely set with glands, dentate, teeth longer at base, cell walls clathrate throughout, walls thicker in the acumen towards apex, cells hyaline, superficial hairs absent; small scales brownish, abundant, persistent, irregularly shaped, 0.06–0.1 mm diam. *Fronde* pinnate, stipe 2–3.5 mm thick, 0.2–0.7 × as long as the lamina, glabrous; lamina 20–60(–70) by 8–15(–20) cm, index 2.5–4, widest at the middle or equally wide throughout; pinnae articulate, sessile at the base of the lamina, to adnate and decurrent on the rachis in at least the upper 1/3 of the lamina, 8–11 by 1–1.3 cm, index 8–8.5, base cordate or auricled, rarely truncate or cuneate, margin entire to crenate, apex narrowly acute to acuminate; basal pair 1.5–4.5 cm distant from next pair and equally long, uppermost pinnae not strongly reduced, apical segment conform, sometimes lobed at the base, as long as or slightly longer than longest

pinnae. *Venation*: areoles uniserial, marginal veinlets to half as long as the areole, simple or forked, frequently anastomosing to form empty areoles. Indument: 2–5-celled glandular hairs present, acicular hairs absent, scales deciduous or sometimes persistent. *Sori* uniserial, medial, superficial, 0.8–1.5 mm diam., receptacular scaly paraphyses persistent, clathrate, peltate, stellate or deltoid, 150–250 by 140–250 μ m, 3 or more cells wide. Sporangia glabrous. Spores yellow, cristate, without polar excrescences.

Distribution — Himalaya to Japan (one record), Indochina; in *Malesia*: Philippines.

Habitat — In forests, mostly epiphytic on mossy tree trunks, rarely on cliffs or terrestrial. Altitude 1200–1700 m.

Notes — 1. The rhizome branches frequently and may form large clusters.

2. This species appears to be seasonal. It hardly grows under perhumid, lowland conditions.

3. Occasionally the margin of the pinnae is more serrate, and the pinnae alternate on the rachis.

6. *Goniophlebium percussum* (Cav.) Wagner & Grether

Goniophlebium percussum (Cav.) Wagner & Grether, Occ. Pap. B. P. Bish. Mus. 19 (1948) 88; Copel., Fern Fl. Philipp. (1960) 460; Rödl-Linder, Philipp. J. Sc. 116 (1987) 155; Blumea 34 (1990) 381. — *Cyathea percussa* Cav., Descr. Pl. (1802) 548. — *Schellolepis percussa* Pichi Serm., Webbia 28 (1973) 470. — *Polypodium cyathoides* Sw., Syn. Fil. (1806) 37, nom. nov., non *Polypodium percussum* Cav.; C. Chr., Dansk Bot. Ark. 9 (1937) 29. — *Goniophlebium cyathoides* Hosokawa, Trans. Nat. Hist. Soc. Form. 32 (1942) 286. — *Polypodium cyathoides* forma *typicum* C. Chr., Ark. f. Bot. 9 (1910) 39, nom. illeg. — Type: *Née* (not traced in MA; 1 pinna in S-PA), Marianas.

[*Polypodium verrucosum* Wall., Cat. (1828) n. 296, nom. nud.] — *Marginaria verrucosa* Hook. & Bauer, Gen. Fil. (1838) pl. 14. — *Goniophlebium verrucosum* J. Sm., Cat. Cult. Ferns (1857) 4; Bedd., Handb. Ferns Brit. India (1883) 324. — *Schellolepis verrucosa* J. Sm., Ferns Brit. & For. (1866) 83; Hist. Fil. (1875) 93. — *Polypodium verrucosum* Mett., Farngatt. I. Polypodium (1856) 81; Hook., Gard. Ferns (1864) pl. 41; Sp. Fil. 5 (1864) 31; Baker, Syn. Fil., ed. 2 (1883) 344; Copel., Philipp. J. Sc., Bot. 2 (1907) 139; Holttum, Revis. Fl. Malaya 2 (1955) 206, f. 106. — *Polypodium cyathoides* var. *verrucosum* C. Chr., Ark. f. Bot. 9 (1910) 39, nom. illeg. — Type: *Wallich* 296 (K).

Polypodium cuspidatum auct. non Don: Mett., Farngatt. I. Polypodium (1856) 81.

Polypodium koningsbergeri auct. non Alderw.: C. Chr., Dansk Bot. Ark. 9 (1937) 29.

Rhizome terete, 5–11 mm thick, brown; phylloids 1.5–2.5 cm distant. Anatomy: vascular strands 14–19, with dark bundle sheaths, sclerenchyma strands many (70–100). *Rhizome scales* inserted evenly, deciduous, densely set, appressed, pseudo-peltate, monomorphic, deltoid, 2.5–4 by 0.7–1.3 mm, index 2.8–3.6, basal auricles rounded, margin at the base sparsely set with glands, dentate, teeth all equally long or slightly shorter at base, apex acuminate to filiform, cell walls equally clathrate throughout, superficial hairs present, spread over the entire acumen. *Fronde* pinnate, stipe 3.5–5 mm thick, 0.2–0.6 \times as long as the lamina, glabrous; lamina 38–99(–200) by 18–38(–45) cm, index 2.1–4.4, widest at the base; pinnae articulate, shortly petiolate, 12.5–20.5 by 2–3 cm, index 6.2–6.8, base shortly angustate, margin entire to crenate, apex acuminate; basal pair 2–6 cm distant from next pair and equally long,

not deflexed, apical segment conform, slightly longer than longest pinnae/segment. *Venation*: areoles 3- or 4-serial, marginal veinlets up to 1/3 as long as the areole, simple or forked, frequently anastomosing. *Indument*: 2-celled glandular hairs present, acicular hairs absent to dense all over the lamina, 2–5 cells long, scales deciduous. *Sori* uniserial, costal, deeply sunken, 0.8–1 mm diam., receptacular scaly paraphyses persistent, clathrate, 230–250 by 180–200 μm , 3 or more cells wide. Sporangia glabrous. Spores yellow, cristate, with short polar excrescences. — **Fig. 7c.**

Distribution — Ranging from Thailand to Australia (Queensland); in *Malesia*: Peninsular Malaysia, Singapore, Sumatra, Java, Borneo, Philippines, New Guinea.

Habitat — Terrestrial or epiphytic; in forest, on mossy, often rotten tree trunks, also terrestrial in wet loose soil. In savannahs amongst persistent leaf bases of palms. Altitude from sea level to 1100(–1600) m.

Notes — 1. Juvenile plants may have very long terminal segments.

2. This species is very similar to *G. persicifolium*, but fresh specimens can be distinguished by the extremely flexible rachis.

Other diagnostic characters are:

	<i>percussum</i>	<i>persicifolium</i>
sclerenchyma strands	70–100	40–50
glands on scales	rare, basal	frequent
laminar acicular indument	present	absent
sori	deeply impressed, < 1 mm diam.	slightly impressed, > 1.8 mm diam.
paraphyses	present in ring	absent

7. *Goniophlebium persicifolium* (Desv.) Bedd.

Goniophlebium persicifolium (Desv.) Bedd., Suppl. Ferns Brit. India (1876) 21 ('*persicaefolium*'); Copel., Fern Fl. Philipp. (1960) 459; Rödl-Linder, Philipp. J. Sc. 116 (1987) 157; Blumea 34 (1990) 383. — *Polypodium persicifolium* Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 316 ('*persicaefolium*'); Baker, Syn. Fil. (1867) 344; Holttum, Revis. Fl. Malaya 2 (1955) 206. — *Schellolepis persicifolia* Pichi Serm., Webbia 28 (1973) 470. — Type: *Anonymous* (P-Juss, fragment), Java.

Polypodium grandidens [Kunze, Index Filic. Hort. Bot. Lips. (1843), nom. nud.] Mett., Fil. Hort. Bot. Lips. (1856) 33, pl. 23; Hook., Sp. Fil. 5 (1864) 31. — *Goniophlebium grandidens* Fée, Gen. Filic. (1850–1852) 255. — Type: a specimen cultivated in Hort. Bot. Leipzig (LZ, destroyed).

Polypodium colpothrix Kunze, Linnaea 23 (1850) 276, 316. — Type: a specimen cultivated in Hort. Bot. Amsterdam (LZ, destroyed).

Polypodium phlebodioides Copel., Polypod. Philipp. (1905) 123; Philipp. J. Sc. 1, Suppl. (1906) 162. — Type: *Copeland 1762a* (MICH), Philippines, Mindanao.

Polypodium integrus Copel., Philipp. J. Sc., Bot. 2 (1907) 439, '*integriore*'. — Type: *Merrill 6005* (MICH), Philippines, Mindoro.

Polypodium koningsbergeri Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 21, non Rosenstock (1912); C. Chr., Ark. f. Bot. 9 (1910) 38. — Type: *Alderwerelt s.n.* (?BO, not traced), Java.

Polypodium persicifolium var. *mettenii* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 13 (1914) 220. — Type: *Winkler 77a* (not traced), Sumatra.

Polypodium cuspidatum auct. non Don (1825); Blume, Enum. Pl. Javae (1828) 132; Fl. Javae Fil. (1830) 132; Hook., Sp. Fil. 5 (1864) 32; Bedd., Ferns Brit. India (1865) t. 79; J. Sm., Ferns Brit. & For. (1866) 82.

Rhizome terete, 5–10 mm thick, brown; phyllopods 2–3 cm distant. Anatomy: vascular strands 10–17, with dark bundle sheaths, sclerenchyma strands many (40–50). *Rhizome scales* inserted evenly, deciduous, densely set, appressed, pseudopeltate, monomorphic, deltoid, 1.8–5 by 0.8–2 mm, index 2.2–3.3, basal auricles rounded, margin set with 1- or 2-celled glands, short-dentate, teeth all equally long or slightly longer at base, apex acuminate, cell walls equally clathrate throughout, superficial rhizoidal indument present, spread over the acumen. *Fronds* pinnate, stipe 3–4.5 mm thick, 0.5–0.7 × as long as the lamina, glabrous; lamina 35–60(–150) by (14–)20–38 cm, index 1.5–3.9, widest at the base; pinnae articulate, mostly distinctly petiolate, 20–22 by 2–2.5 cm, index 8.8–10, base angustate, margin entire to crenate, apex acuminate; basal pair 3–6 cm distant from the next pair and equally long, not deflexed, apical segment conform, equally long as or slightly longer than longest pinnae. *Venation*: areoles 2–4-serial, marginal veinlets up to 1/3 as long as the areole, simple or forked, frequently anastomosing. Indument: 2-celled glandular hairs present, acicular hairs usually absent, sometimes sparsely present on costa and veins on lower surface, scales deciduous. *Sori* uniserial, costal, slightly sunken, 1.8–2.2 mm diam., receptacular scaly paraphyses deciduous, clathrate, 90–110 by 60–80 µm, 2 or more cells wide. Sporangia glabrous. Spores yellow, cristate, with short polar excrescences.

— **Fig. 7a, 8a, b.**

Distribution — Himalayas to the Pacific; throughout *Malesia*.

Habitat — In forest, mostly epiphytic, rarely terrestrial in loose soil. Altitude 150–1900 m.

Note — *Polypodium grandidens* was described on the basis of a cultivated plant originating from the Malay Peninsula with dark brown rhizome scales with 2-celled marginal glands, and with a strongly serrate pinna-margin. Some specimens from Java are similarly serrate.

8. *Goniophlebium rajaense* (C. Chr.) Parris

Goniophlebium rajaense (C. Chr.) Parris, Brit. Fern Gaz. 12 (1980) 118; Rödl-Linder, Blumea 34 (1990) 384. — *Polypodium rajaense* C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 159. — *Polypodium integrus* var. *rajaense* C. Chr., Ind. Fil., Suppl. 3 (1934) 151, 157. — Type: *H. Winkler 980b* (HBG), Borneo.

Rhizome dorsiventrally flattened, ventrally grooved when dry, 3–4 by 2–3 mm thick, brown; phyllopods 2–7 cm distant. Anatomy: vascular strands 10–12, with dark bundle sheaths, sclerenchyma strands few, up to c. 20. *Rhizome scales* inserted evenly, persistent, densely set, appressed at base, often with a strongly squarrose acumen, pseudopeltate, monomorphic, deltoid, 1.7–3.4 by 0.6–1.2 mm, index 2.6–2.9, basal auricles rounded, margin at the base sparsely set with glands, dentate, teeth longer at base, apex filiform, entire or finely dentate, cell walls clathrate throughout, more strongly thickened in the central part of the acumen, yellowish, superficial hairs present. *Fronds* pinnate, stipe 3–4 mm thick, 0.5 × as long as the lamina, glabrous; lamina 50–60 by 26–30 cm, index 1.7–1.9, widest at the base; pinnae articulate, shortly petiolate, 15–19 by 1.5–2.7 cm, index 7–10, base angustate, margin entire to crenate, apex acuminate to caudate; basal pair 2–3 cm distant from next pair and equally long, not deflexed, apical segment conform, equally long as or slightly shorter

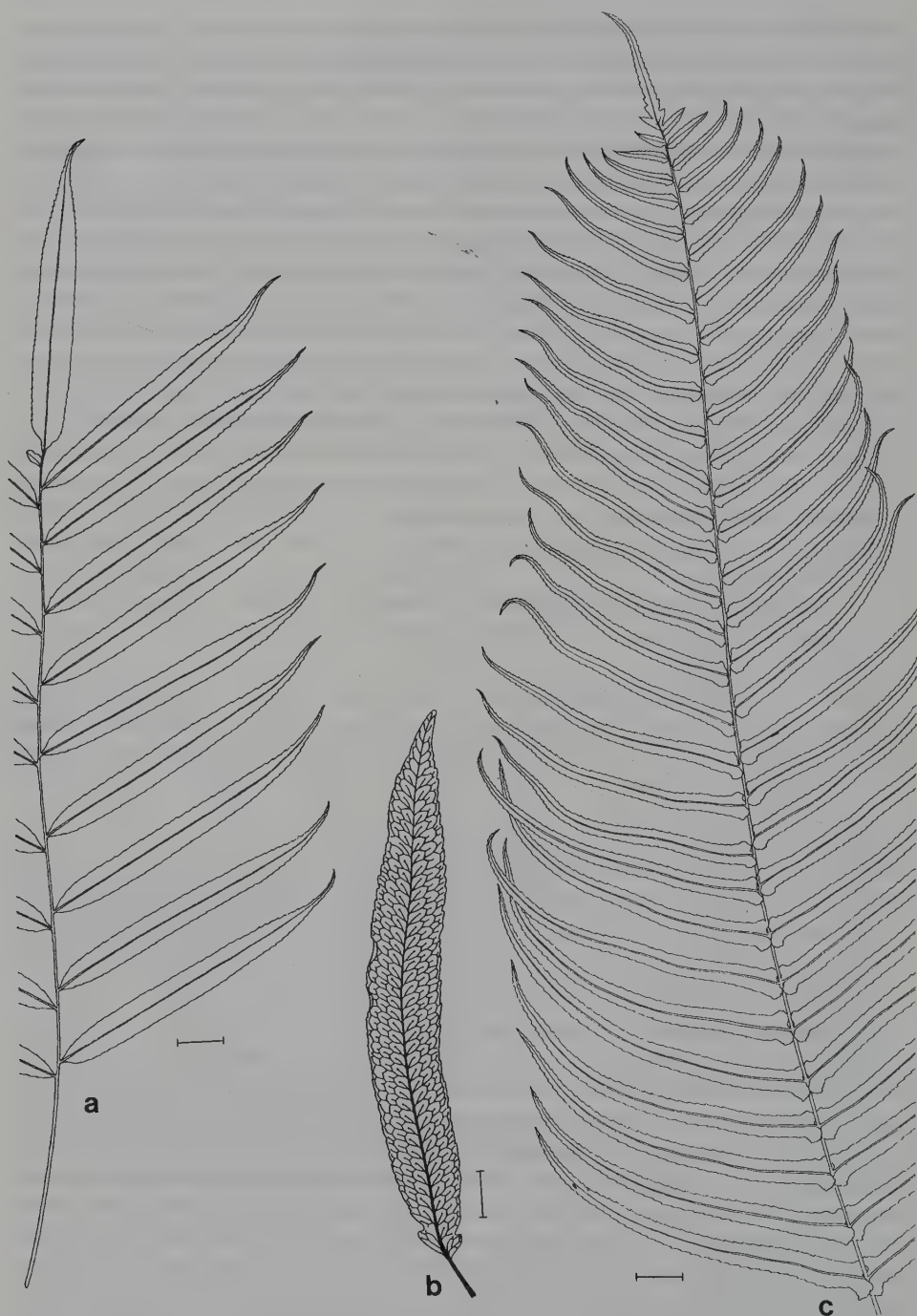


Fig. 8. *Goniophlebium*. — *G. persicifolium* (Desv.) Bedd. a. Adult frond; b. venation. — *G. pseudoconnatum* (Copel.) Copel. c. Adult frond. — Scale bars: a, c = 5 cm, b = 8 mm. Reproduced from Blumea 34 (1990).

than longest pinnae. *Venation*: areoles 3-serial, marginal veinlets up to $1/3$ as long as the areole, simple or forked, often anastomosing. Indument: 2-celled glandular hairs present, acicular hairs absent. *Sori* uniserial, costal, slightly sunken, 2–3 mm diam., receptacular scaly paraphyses persistent, clathrate, 90–410 by 80–205 μm , 3 or more cells wide. Sporangia glabrous. Spores yellow, cristate, with short polar excrescences.

Distribution — *Malesia*: Borneo, scattered.

Habitat — Primary forest, epiphytic, also terrestrial, on friable soil. Altitude 650–2000(–2900) m.

9. *Goniophlebium serratifolium* Brackenr.

Goniophlebium serratifolium Brackenr. in Wilkes, U.S. Expl. Exped., Filic. (1854) 35; Rödl-Linder, Blumea 34 (1990) 385. — *Polypodium subauriculatum* var. *serratifolium* Hook., Sp. Fil. 5 (1864) 33, p.p. — *Polypodium serratifolium* Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 312. — Type: *Brackenridge s.n.* (US), Fiji.

Goniophlebium subcordatum Copel., Univ. Calif. Publ. Bot. 18 (1942) 226. — Type: *Brass 14045* (MICH), New Guinea.

Rhizome terete, 4–6 mm thick, brown; phylloids 1–2 cm distant. Anatomy: vascular strands 6–13, with dark bundle sheaths, sclerenchyma strands many (> 100). *Rhizome scales* inserted evenly, persistent, densely set, spreading, pseudopeltate, monomorphic, deltoid, 2.6–3.9 by 0.8–1 mm, index 3.2–3.9, basal auricles pointed, margin at the base set with frequent glands, dentate, apex acuminate, cell walls clathrate, slightly more strongly thickened in the central part of the acumen, superficial hairs absent. *Fronde* pinnate, stipe 4–9.5 mm thick, 0.7–0.9 \times as long as the lamina, glabrous; lamina 50–15 by 23–50 cm, index 2.2–3, widest at the base; pinnae articulate, sessile, 14–24 by 1.1–1.3 cm, index 12.7–18.5, base cuneate, rarely truncate, margin serrate, apex acuminate, basal pair 3–4 cm distant from next pair and equally long, not deflexed, apical segment conform, half as long as longest pinnae. *Venation*: areoles 1- or 2-serial, marginal veinlets 1–3 per areole, well-developed, simple or rarely forked, frequently anastomosing. Indument: 2- or 3-celled glandular hairs present, acicular hairs sparsely present near the margins, 2–4 cells long, scales persistent. *Sori* uniserial, costal, superficial, 1.5–3 mm diam., receptacular scaly paraphyses persistent, clathrate, 100–200 by 100–130 μm , 2 cells wide. Sporangia glabrous. Spores yellow, cristate, with short polar excrescences.

Distribution — *Malesia*: West New Guinea (one record only). Outside *Malesia*: Fiji and Samoa Islands.

Habitat — Epiphytic in dense forest, also terrestrial in ridge forest. Altitude 50–1000 m.

Note — This species has been confused with *G. subauriculatum*. Conspicuous differences can be found in the rhizome, which is brown, not chalky, the base of the pinnae which is cuneate, not truncate, and the scaly paraphyses, which are never stellate.

10. *Goniophlebium terrestre* Copel.

Goniophlebium terrestre Copel., Philipp. J. Sc. 56 (1935) 106, 107, pl. 13, 14; Fern Fl. Philipp. (1960) 460; Rödl-Linder, Philipp. J. Sc. 116 (1987) 161; Blumea 34 (1990) 386. — *Schellolepis terrestris* Price, Kalikasan, Philipp. J. Biol. 3 (1974) 178; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 158. — Type: *Copeland 272* (MICH), Philippines, Luzon.

Rhizome dorsiventrally flattened, 1.8–3 by 1.5–2.6 mm thick, brown; phylloids 4–9 cm distant. Anatomy: vascular strands 6–9, with dark bundle sheaths, sclerenchyma strands few (3–11). *Rhizome scales* inserted evenly, persistent, densely set, squarrosely spreading, pseudopeltate, monomorphic, deltoid, 3–4.7 by 0.8–1.1 mm, index 3.5–4.3, basal auricles rounded, margin sparsely set with glands, base irregularly dentate, acumen finely dentate, apex filiform, nearly entire, cell walls clathrate in the acumen, not thickened in the basal auricles, superficial hairs absent. *Fronde* pinnate, stipe 1.1–1.8 mm thick, 0.5–0.8 × as long as the lamina, glabrous; lamina 7–19 by 4–14 cm, index 1.3–1.7, widest at the base; pinnae articulate, sessile to shortly petiolate, 4.5–9 by 0.6–1.5 cm, index 6–7.5, base cuneate to shortly angustate, margin entire to serrate, more strongly towards the apex, apex acuminate; basal pair 1.3–2.5 cm distant from next pair and equally long, sometimes somewhat deflexed, apical segment conform, shorter to longer than longest pinnae, usually more longly acuminate. *Venation*: areoles uniserial, marginal veinlets up to 1/5 as long as the areole, simple. Indument: 2-celled glandular hairs present, acicular hairs absent, scales deciduous. *Sori* uniserial, medial to marginal, superficial, 1.6–2 mm diam., receptacular scaly paraphyses persistent, sometimes peltate, clathrate, 210–320 by 140–210 µm, 2 or more cells wide. Sporangia glabrous. Spores yellow, cristate, with long polar excrescences. — **Fig. 7b.**

Distribution — *Malesia*: Philippines (Luzon, known from Mt Makiling only).

Habitat — Primary mossy forest, low epiphyte or epilithic on mossy or bare rocks, rarely terrestrial in loose humus. Altitude 500–850 m.

Note — Collections of this species are rare, but sufficient to note that the restricted altitudinal range is not due to undercollecting.

11. *Goniophlebium prainii* Bedd.

Goniophlebium prainii Bedd., J. Bot. 31 (1893) 226; Rödl-Linder, Blumea 34 (1990) 397. — *Polypodium prainii* C. Chr., Index Filic. (1906) 556; Holttum, Revis. Fl. Malaya 2 (1954) 204. — *Polypodiastrium prainii* Ching, Acta Phytotax. Sin. 16 (1978) 28; Acta Bot. Yunn. 1 (1979) 31, comb. illeg. — Type: *Scortechini s.n.* (P), Perak.

Rhizome terete, 3.5–4.5 mm thick, brown; phylloids 1.5–10 cm distant or more. Anatomy: vascular strands 11–14, with dark bundle sheaths, sclerenchyma strands many, up to 50–60. *Rhizome scales* inserted evenly or on protrusions, deciduous, densely set, rather suddenly contracted from a wide base to a squarrose, slightly channeled acumen, basifixed or pseudopeltate, monomorphic, deltoid, 2.1–7.3 by 0.4–2.1 mm, index 3.5–2.2, basal auricles rounded, margin of the acumen sparsely set with glands, base entire to dentate, acumen entire or denticulate, apex filiform, cell walls clathrate throughout, more strongly thickened in the central part of the acumen, sometimes forming a light pseudomidrib, superficial hairs absent. *Fronde* pinnatifid, stipe 3–4 mm thick, 0.6–0.8 × as long as the lamina, hairy; lamina 20–45 by 18–28 cm, index 1.1–1.6, widest near the base; segments 10–15 by 1.3–1.5 cm, index 7.7–10, base of lowest pinnae cordate on basiscopic side, margin entire to crenate, apex acuminate, basal pair 1.5–4.5 cm distant from next pair and equally long, basal 1 or 2 pairs rather strongly deflexed, apical segment not sharply distinct. *Venation*: areoles 1- or 2-serial, marginal veinlets up to half as long as the areole, simple or forked,

frequently anastomosing to form areoles without included veinlets. Indument: 2–4-celled glandular hairs present, acicular hairs present on upper surfaces of midrib and costae, sometimes also on lower surfaces and on the lamina, 2–5 cells long, scales deciduous or sometimes persistent. *Sori* uniserial, costal, superficial, 1.5–2 mm diam., receptacular scaly paraphyses persistent, clathrate, 140–180 by 90–140 μm , 2 cells wide. Sporangia glabrous. Spores yellow, reticulate, without polar excrescences.

Distribution — *Malesia*: Peninsular Malaysia, N Sumatra.

Habitat — In forest, epiphytic on mossy, rotten tree trunks, near ground level, in shady localities or exposed. Altitude 1100–1900 m.

Note — The hairiness of the fronds is highly variable, even in one collection there may be fronds that are virtually glabrous alongside fronds that are hairy all over.

12. *Goniophlebium pseudoconnatum* (Copel.) Copel.

Goniophlebium pseudoconnatum (Copel.) Copel., Fern Fl. Philipp. (1960) 462; Rödl-Linder, Philipp. J. Sc. 116 (1987) 158; Blumea 34 (1990) 399. — *Polypodium pseudoconnatum* Copel., Philipp. J. Sc. 1, Suppl. (1906) 161, pl. 22. — Type: *Copeland 1904s* (MICH), Philippines, Luzon.

Rhizome terete, 5–7.5(–10) mm thick, white-waxy; phyllopods 3–5 cm distant. Anatomy: vascular strands 13–15, with dark bundle sheaths, sclerenchyma strands many (30–50). *Rhizome scales* inserted on short protrusions, deciduous, densely set, spreading or erect, basifixed to pseudopeltate, monomorphic, deltoid, 4–5 by 1–1.3 mm, index 3.8–4.1, basal auricles rounded, entire to dentate, acumen entire to dentate, apex narrow but not filiform, cell walls clathrate throughout, cells about isodiametric to elongated, hyaline, margin densely set with 1- or 2-celled glands, superficial glandular indument sporadically present. *Fronds* pinnate, stipe 2.5–5 mm thick, 0.4–0.6 \times as long as the lamina, glabrous; lamina 26–150 by 8–31 cm, index 0.4–0.6, widest near the base or equally wide throughout; pinnae articulate, sessile, 10–14 by 0.8–1.2 cm, index 11.7–12.5, adnate in upper part of the frond, base truncate, cordate or auricled, margin crenate, apex narrowly acute; basal pair 1.5–3.6 cm distant from next pair, sometimes shorter, sometimes deflexed, apical segment not sharply distinct. *Venation*: areoles uniserial, marginal veinlets to nearly as long as the areole, simple or forked, sometimes anastomosing. Indument: 2-celled glandular hairs present, acicular hairs present in variable densities all over the lamina, 2–8 cells long, scales persistent. *Sori* uniserial, medial, slightly sunken, 1.5–2 mm diam., receptacular scaly paraphyses persistent, peltate, stellate, clathrate, 200–240 by 180–200 μm . Sporangia occasionally (15% of all sporangia) with a 2- or 3-celled simple glandular hair. Spores yellow, cristate, without polar excrescences. — **Fig. 7h, 8c.**

Distribution — *Malesia*: Borneo, Philippines, Sulawesi, Moluccas, New Guinea.

Habitat — In forest, epiphytic on mossy trunks, epilithic on limestone rock, terrestrial on loose soil. Altitude (500–)900–2700 m.

Note — *Goniophlebium pseudoconnatum* is closely similar to *G. subauriculatum*, with which it co-occurs. The best distinction is in the rhizome scales, which, in *G. pseudoconnatum*, are dull brown, nearly entire or more strongly dentate near the acumen than at the base, have relatively short, wide cells in the acumen and a relatively wide apex. In *G. subauriculatum* the scales are more rufous, with a strongly and

irregularly dentate base, they have longer, narrower cells in the acument and a long, filiform apex. The distinctions, however, are not completely sharp and intermediates occur. Other, even less clear-cut characters in which the two differ are:

	<i>pseudoconnatum</i>	<i>subauriculatum</i>
sclerenchyma strands in rhizome	30–50	> 100
glandular hairs on scales	1- or 2-celled	1-celled
colour of fresh fronds	dark green	light green
stipe and rachis	firm	very flexible
diameter of sori	1.5–2 mm	1–1.5 mm
sporangia	occasionally hairy	glabrous

Incomplete specimens (without rhizome) cannot be identified with any certainty.

13. *Goniophlebium subauriculatum* (Blume) Presl

Goniophlebium subauriculatum (Blume) C. Presl, Tent. Pterid. (1836) 186; J. Sm., Cat. Cult. Ferns (1857) 3; Bedd., Handb. Ferns Brit. India (1883) 322, 323, f. 173; Copel., Fern Fl. Philipp. (1960) 461; Rödl-Linder, Philipp. J. Sc. 116 (1987) 159; Blumea 34 (1990) 400. — *Polypodium subauriculatum* Blume, Enum. Pl. Javae (1828) 133; Fl. Javae Fil. (1830) 132; Hook., Sp. Fil. 5 (1864) 32; Copel., Philipp. J. Sc., Bot. 2 (1907) 139; Holttum, Revis. Fl. Malaya 2 (1954) 207, f. 108. — *Schellolepis subauriculata* J. Sm., Ferns Brit. & For. (1866) 82; Hist. Fil. (1875) 93; M.G. Price, Thesis, Univ. Philipp. Los Baños (1975) 203, 204. — *Marginaria subauriculata* Nakai ex H. Itô, J. Jap. Bot. 11 (1935) 95, q.n.s. — Type: *Blume 130* (L), Java.

Polypodium pallens Blume, Fl. Javae Fil. (1847) 177, 178, pl. 84. — *Goniophlebium pallens* C. Presl, Tent. Pterid. (1836) 186. — *Schellolepis pallens* J. Sm., Hist. Fil. (1875) 93. — Type: *Kuhl & van Hasselt 206* (L), Java.

Goniophlebium reinwardtii de Vriese, Ned. Kruidk. Arch. 1 (1847) 257; Fée, Gen. Filic. (1850–1852) 255 ('*reinwardtianum*'). — *Polypodium reinwardtii* Kunze, Linnaea 23 (1850) 283, nom. illeg., non C. Presl (1836); Baker, Syn. Fil., ed. 2 (1883) 344. — Type: *van Gesker s.n.* (L), Java.

Goniophlebium pleopeltis Fée, Gen. Filic. (1850–1852) 256; J. Sm., Ferns Brit. & For. (1866) 82. — Type: *Lobb 263* (K), Java.

Polypodium molliculum Copel. in Perkins, Fragm. Fl. Philipp. 3 (1905) 190, nom. illeg., non Link (1841); Philipp. J. Sc. 1, Suppl. (1906) 162. — *Polypodium tomentellum* C. Chr., Index Filic. (1906) 570. — *Goniophlebium tomentellum* Copel., Fern Fl. Philipp. (1960) 461. — *Schellolepis tomentella* Pichi Serm., Webbia 28 (1973) 470; M.G. Price, Thesis, Univ. Philipp. Los Baños (1975) 204. — Type: *Elmer 6506* (PNH, destroyed), Philippines, Luzon.

Goniophlebium integrum Copel., Philipp. J. Sc. 81 (1952) 42; Fern Fl. Philipp. (1960) 461; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 150. — Type: *Merrill 7814* (MICH), Philippines, Luzon.

Rhizome terete, 5–6.5(–10) mm thick, white-waxy; phyllopods 0.5–3 cm distant. *Anatomy*: vascular strands 10–13, with dark bundle sheaths, sclerenchyma strands very many (> 100). *Rhizome scales* inserted on protrusions, deciduous, densely set, erect, basifixed to pseudopeltate, monomorphic, deltoid, 3–6 by 0.6–1 mm, index 4.2–6, basal auricles pointed, with an irregularly dentate margin, acumen dentate, apex filiform, cell walls thinly clathrate throughout, cells yellow, margin densely set with glands, superficial rhizoidal indument often present. *Fronds* pinnate, stipe 1.8–3.3 mm thick, 0.2–0.7 × as long as the lamina, glabrous or occasionally hairy; lamina 20–95(–250) by 7–50 cm, index 2.1–5, widest at the base, the middle or equally wide throughout; pinnae articulate, shortly petiolate to sessile, 8–12 by 0.9–1.8 cm, index

6.7–8.9, adnate in upper part of frond, base cordate or auricled, rarely truncate, margin crenate to, sometimes coarsely, serrate, apex narrowly acute; basal pair 1.5–3.5 cm distant from next pair, sometimes shorter, sometimes deflexed, apical segment not sharply distinct. *Venation*: areoles 1- or 2-serial, second row often with 2 or 3 included veinlets, marginal veinlets to as long as the outermost areole, simple or forked, frequently anastomosing, forming an irregular extra row of areoles with or without included veinlets. Indument: 2-celled glandular hairs present, acicular hairs present in variable densities all over the lamina, 2–8 cells long, scales persistent. *Sori* uniserial, costal to medial, slightly sunken, 1–1.5 mm diam., receptacular scaly paraphyses persistent, basifixed or peltate, stellate, clathrate, 240–260 by 200–220 μm , 3 or more cells wide. Sporangia glabrous. Spores yellow, cristate without polar excrescences. Chromosomes: $n = 37$. — **Fig. 7f.**

Distribution — Indochina to Australia, New Caledonia. Throughout *Malesia* but absent from the Moluccas.

Habitat — Forests, high or low on trunks, also epilithic on limestone or in clefts between rocks; shaded or exposed. Altitude 250–2400 m.

Notes — 1. Juvenile plants are hairy, and the hairiness may persist in varying degrees on older plants. Distinct gradations in hairiness may occur between fronds on the same rhizome.

2. When growing on altitudes over 1500 m a 'mountain form' may develop (*Polypodium pallens* Blume). This form has short, upright fronds, narrow, firm pinnae with a truncate base and a less serrate margin. This growth form does not persist when the plants are grown at lower altitudes.

LECANOPTERIS

(E. Hennipman & P.H. Hovenkamp)

[*Onychium* Reinw., Syllog. Plantarum 2 (1824) 2, nom. illeg., non Kaulf. (1820).] — *Lecanopteris* Reinw., Flora 8 (1825) 3, Beil. 48; Copel., Gen. Fil. (1947) 205; Holtum, Rev. Fl. Malaya 2 (1954) 208; Hennipman, Kew Bull. 41 (1986) 783; Hennipman & Verduyn, Blumea 32 (1987) 313; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 217; H.E. Gay et al., Gard. Bull. Sing. 45 (1993', 1994) 295. — Type species: *Lecanopteris carnosa* (Reinw.) Blume. *Polypodium* sect. *Myrmecophila* H. Christ., Farnkr. Erde (1897) 12. — *Myrmecophila* Nakai, Bot. Mag. Tokio 43 (1929) 6, nom. illeg., non Rolfe (1917). — *Myrmecopteris* Pichi Serm., Webbia 31 (1977) 231. — Lectotype species (Pichi Sermolli, l.c.): *Lecanopteris sinuosa* (Hook.) Copel.

Epiphytic, very rarely epilithic, ant-inhabited ferns. *Rhizome* creeping, with hollow spaces inside or below; glabrous, hairy or with peltate scales, smooth, or spiny; with two rows of fronds or fronds replaced by spines or coralloid excrescences. *Rhizome scales* peltate, clathrate with a dark centre with more or less isodiametric, clathrate cells and a flabelloid margin with elongated, thin-walled cells; or scales very small or absent. Phylloids usually distinct, hollow and protruding or solid and unprotruding. *Fronds* simple to deeply pinnatifid, sessile or stipitate; chartaceous to coriaceous. *Venation* forming into a complex network with included free veinlets. *Sori* immersed, in two rows on the lamina on either side of the costa, or on marginal excurrent teeth. Sporangia stalked, with 64 or rarely 16 spores. Spores monolete, orange, translucent, smooth or filamentous (*L. mirabilis*). — **Fig. 9–13.**

Distribution — Southern Indochina; throughout *Malesia*.

Notes — 1. Habitat and distributional data for all species are mainly compiled from Gay et al. (1994).

2. All species are myrmecophytes. The ecological aspects of the fern–ant association are described in Gay et al. (1994, and references therein). The association is mutualistic, the plants providing shelter for the ants, the ants providing nutrients for the plants. It is not an evolutionary, historical constrained association: the species of ants inhabiting a particular species of *Lecanopteris* are replaced by other species whenever the distribution of a fern species is wider than that of an inhabiting ant. The surprisingly high number of endemic species in Sulawesi is so far not explained.

Taxonomy — Two subgenera are distinguished (Hennipman in Gay et al. 1994):

Subgenus *Lecanopteris*: rhizome with inconspicuous, deciduous, deltoid scales, otherwise often with dense short glandular hairs, conspicuous spines or other large outgrowths; sori immersed on the lamina or in marginal lobes. All species have very conspicuously thickened, hollow rhizomes, often forming large clumps or balls around the branches of the host tree. The presence of sori on the lamina in two species (*L. spinosa* and *L. balgooyi*) indicates affinity with the previous subgenus, otherwise this is a very distinct group. The rhizome is usually green or glaucous when young, and blackening with age. In several species it is covered with strong spines. Sometimes these clearly represent modified fronds, set in two rows on the dorsal side of the rhizome; in other species they are much more densely set. The coralloid outgrowths present in *L. carnosa* are clearly derived from frond primordia.

Subgenus *Myrmecopteris*: rhizome with conspicuous, persistent, orbicular, peltate scales, otherwise glabrous; sori immersed on the lamina; *L. mirabilis*, *L. lomarioides*, *L. crustacea* and *L. sinuosa*. *Lecanopteris mirabilis* has flattened rhizomes, the other species have more or less strongly thickened and hollow rhizomes. This subgenus has been given generic rank by Pichi Sermolli (1977). It is included in *Phymatodes* (= *Microsorium*) by Holttum (1954), to which it obviously is closely allied, with *L. sinuosa*, possessing relatively thin rhizomes, most nearly occupying an intermediate position.

References: Gay, H.E., E. Hennipman, C.R. Huxley & F.J.E. Parrot, The taxonomy, distribution and ecology of the epiphytic Malesian ant-fern *Lecanopteris* Reinw. (Polypodiaceae). Gard. Bull. Sing. 45 ('1993'; 1994) 293–335. — Holttum, R.E., Revised Flora of Malaya 2 (1954) 208. — Pichi Sermolli, R.E.G., Webbia 31 (1977) 231.

KEY TO THE SPECIES

- 1a. Rhizome covered with peltate scales (Subg. *Myrmecopteris*) 2
- b. Rhizome not covered with peltate scales (Subg. *Lecanopteris*) 5
- 2a. Rhizome massive, strongly flattened, arched, scales sparse, not completely covering the surface **3. *L. mirabilis***
- b. Rhizome hollow, thick, scales dense, covering the surface 3
- 3a. Fronds simple, rhizome little-branched **4. *L. sinuosa***
- b. Fronds pinnatifid, rhizome frequently branched 4
- 4a. Rhizome a uniform structure, all branches hollow, scales mostly with a brown centre **1. *L. crustacea***

- b. Rhizome consisting of solid, frond-bearing main branches and hollow, ovate or irregularly shaped, frondless lateral branches, the scales mostly with a blackish centre **2. *L. lomarioides***
- 5a. Rhizome and fronds glaucous, naked **9. *L. deparioides***
- b. Rhizome green, with spines, coralloid outgrowths or dense glandular indumentum (lens!), or stipe and rachis with hairs below 6
- 6a. Rhizome with spines or coralloid outgrowths in two rows, replacing fronds; a single internal gallery system; and hollow, protruding phyllopods 7
- b. Rhizome with irregular, dense cover of spines or coralloid outgrowths not replacing fronds; two internal gallery systems; and solid phyllopods 11
- 7a. Rhizome with hollow spines; fronds entire to pinnatifid **5. *L. balgooyi***
- b. Rhizome with solid spines or coralloid outgrowths; fronds pinnatifid 8
- 8a. Rhizome with coralloid outgrowths 1–3 cm long **6. *L. carnosa***
- b. Rhizome with spines 9
- 9a. Large plants; rhizome 2.5–3.5 cm thick, with abundant spines; fronds up to 1 m long **7. *L. celebica***
- b. Smaller plants; rhizome to 2.5 cm thick, with few spines; fronds up to 45 cm long 10
- 10a. Rhizome covered with short hairs and scattered scales, stipe and rachis glabrous, sori round **12. *L. pumila***
- b. Rhizome glabrous except near apex, stipe and rachis with persistent hairs below, sori laterally flattened **11. *L. luzonensis***
- 11a. Fronds simple, sori deeply immersed on lamina **13. *L. spinosa***
- b. Fronds pinnatifid, sori on marginal lobes 12
- 12a. Veins not sclerified, green, sori on stalked, unreflexed lobes . **10. *L. holttumii***
- b. Veins sclerified, appearing black; sori on unstalked, reflexed lobes **8. *L. darnaedii***

1. *Lecanopteris crustacea* Copel.

Lecanopteris crustacea Copel., Univ. Calif. Publ. Bot. 12 (1931) 406; H.É. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 300. — *Phymatodes crustacea* Holttum, Revis. Fl. Malaya 2 (1955) 190. — Type: *Burchard 158* (UC).

Rhizome much-branched, hollow throughout, 3–5 cm thick, densely covered with scales. Scales orbicular, 2–2.3 mm diam., with central cells with lumina concolorous with the immediate surrounding cells, forming a ferruginous centre, margin not glandular. Phyllopods solid, not prominent. *Fronds* dimorphic, stalked, deeply pinnatifid, fertile fronds more deeply than sterile ones; mid-green, coriaceous. Fertile fronds with stalks 10–28 cm long, 2–5 mm thick, lamina 30–60 by 10–20 cm, pinnae to 0.4 cm wide, linear. Sterile fronds with stalks 4–18 cm long, lamina 12–22 by 8–12 cm, pinnae obovate, 1–2 cm wide, base often narrowed, apex rounded. *Venation* with one row of areoles with branching recurrent included veinlets. *Sori* 2 mm diam., deeply immersed, in a single row on each side of the costa, forming papillae to 1 mm high on the abaxial surface, to 60 on each pinna. Sporangia c. 0.5 mm long; spores 64.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Borneo.

Habitat — Epiphytic, in lowland evergreen and freshwater swamp forest.

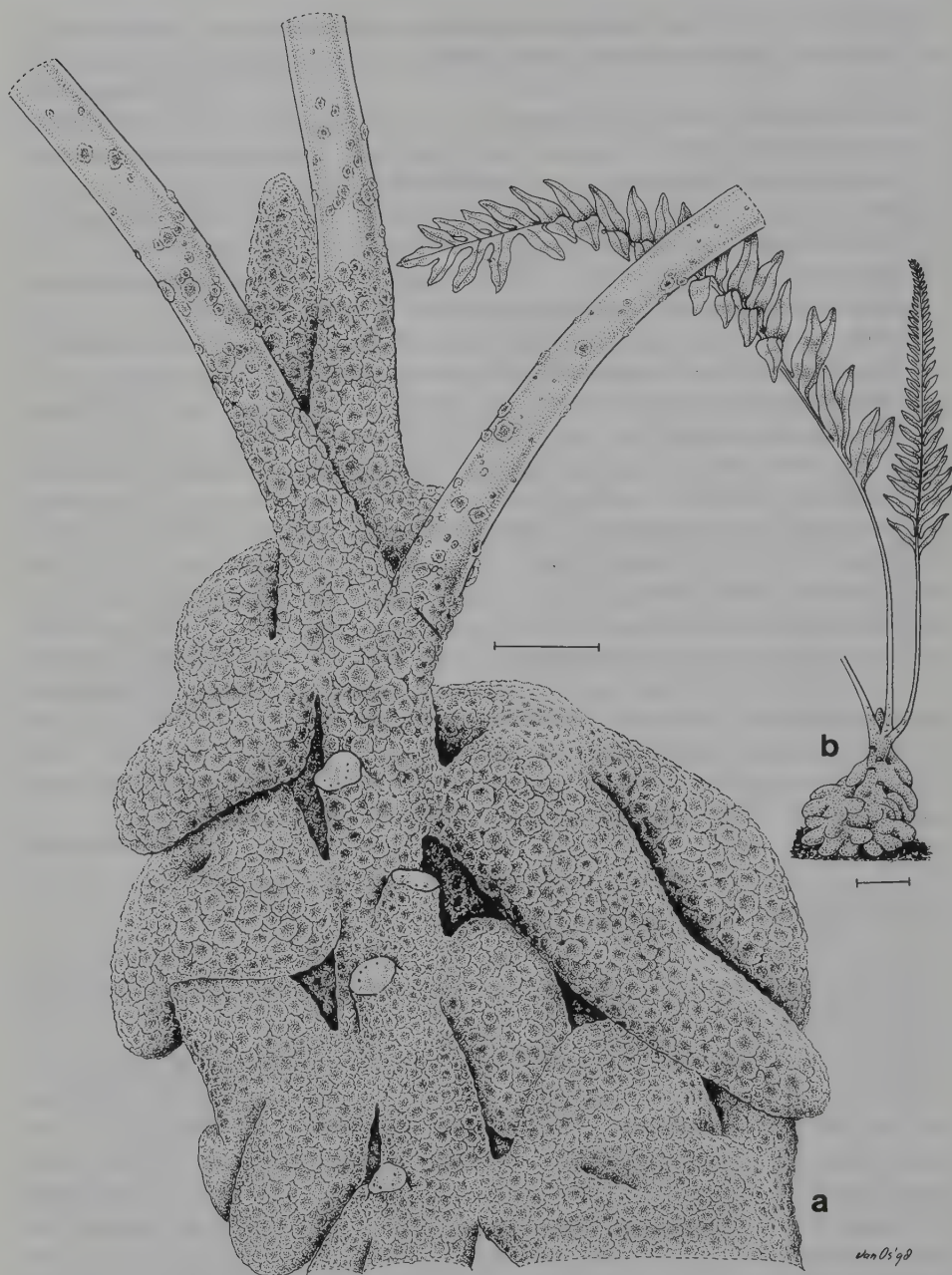


Fig. 9. *Lecanopteris lomarioides* (Mett.) Copel. a. Habit; b. rhizome (a cultivated specimen in Leiden Botanical Garden). Scalebars: a = 6 cm, b = 2.5 cm. Drawings by J.H. van Os.

2. *Lecanopteris lomarioides* (Mett.) Copel.

- Lecanopteris lomarioides* (Mett.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 123; Fern Fl. Philipp. (1960) 499; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 151; R.J. Johns, Curtis's Bot. Mag. 12 (1995) 89. — [*Drynaria lomarioides* J. Sm., J. Bot. (Hook.) 3 (1841) 397, nom. nud.] — *Polypodium lomarioides* Mett., Farngatt. 1. Polypodium (1856) 102, pl. 2: 18-19; Baker, Syn. Fil. (1867) 365; Alderw., Mal. Ferns (1908) 623. — *Pleopeltis lomarioides* T. Moore, Index Filic. (1857) 78; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — *Myrmecophila lomarioides* H. Itô, Bot. Mag. (Tokyo) 34 (1929) 6. — *Myrmecopteris lomarioides* Pichi Serm., Webbia 31 (1977) 240. — Type: *Cuming* 242 (K; iso BM, L, P, US), Philippines, Luzon.
- Polypodium sarcopus* Teijsm. & Binn., Natuurk. Tijdschr. Ned. Ind. 29 (1867) 241; Alderw., Malayan Ferns (1908) 624. — *Pleopeltis sarcopus* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — *Lecanopteris sarcopus* Copel., Univ. Calif. Publ. Bot. 16 (1929) 123; Hennipman & Verduyn, Blumea 32 (1987) 318; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 298. — *Myrmecophila sarcopus* Nakai, Bot. Mag. (Tokyo) (1929) 6; Ching, Sunyatsenia 5 (1940) 259. — *Myrmecopteris sarcopus* Pichi Serm., Webbia 31 (1977) 240. — Type: *Teijsmann & de Vriese* 75 (?BO; iso BM, K, L), Celebes.
- Polypodium sauvinierei* Baker, Ann. Bot. (London) (1891) 480. — *Pleopeltis sauvinierei* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10. — Type: *de la Sauvinère* 382 (K), Celebes.
- Polypodium myrmecophilum* H. Christ, Verh. Naturf. Ges. Basel 11 (1896) 24, pl. 3 f. 21-24. — Type: *Sarasin* 58 (?P), Celebes.

Rhizome much branched, with solid, cylindrical frond-bearing central parts, 1-2 cm thick and hollow, frondless lateral branches 2-3 cm thick, with rounded apex; all densely covered with scales. Scales orbicular, 2-3 mm diam., central cells with hyaline lumina, distinctly different in colour from the immediate surrounding brownish cells, forming a distinct blackish spot, margin without glands. Phyllopois solid, prominent, 1-1.5 cm high. *Fronds* monomorphic to slightly (internally) dimorphic, stalked, deeply pinnatifid; stipe 10-30 cm long, 2-5 mm thick; lamina 20-110 by 9-20 cm, decurrent on the stipe, mid-green, coriaceous. Pinnae perpendicular to the rachis or slightly ascending, sterile ovate, 1-2.2 cm wide, narrowed at the base. *Venation* with several rows of areoles with branching recurrent included veinlets; fertile 0.5-1.7 cm wide. *Sori* 1-2 mm diam., deeply immersed, in a single medial row on each side of the costa, 30-60 on each pinna, forming papillae to 1 mm high on the abaxial surface. Sporangia c. 0.25 mm long, on stalks to 0.25 mm long; spores 64 in each sporangium, to 50 µm long. — **Fig. 9.**

Distribution — *Malesia*: Philippines, Sulawesi.

Habitat — Epiphytic, in everwet lowland and hill forest, also in disturbed situations, roadside trees. Altitude from sea level to 1000 m.

3. *Lecanopteris mirabilis* (C. Chr.) Copel.

- Lecanopteris mirabilis* (C. Chr.) Copel., Univ. Calif. Pub. Bot. 16 (1929) 123 ('*mirabile*'); Gen. Fil. (1947) 205; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 298, f. 2. — *Polypodium imbricatum* G. Karst., Ann. Jard. Bot. Buitenzorg 12 (1895) 168, nom. illeg., non Liebmann (1849); Alderw., Mal. Ferns (1908) 624. — *Polypodium mirabile* C. Chr., Ind. Fil. (1906) 545. — *Pleopeltis imbricata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3, nom. illeg. — *Myrmecopteris mirabilis* Pichi Serm., Webbia 31 (1977) 237. — Type: *Karsten s.n.* (?BO, n.v.), Ambon.
- Polypodium ulotheca* Brause, Bot. Jahrb. Syst. 56 (1920) 204. — *Myrmecophila ulotheca* Ching, Sunyatsenia 5 (1940) 260. — *Myrmecopteris ulotheca* Pichi Serm., Webbia 31 (1977) 237. — Type: *Ledermann* 12641 (B), New Guinea.



Fig. 10. *Lecanopteris mirabilis* (C. Chr.) Copel. Habit (a cultivated specimen in Leiden Botanical Garden). Scale bar = 4 cm. Drawing by J.H. van Os.

Rhizome solid, flattened, plate-like, 10–20 cm wide, arched, with a hollow space between the dark underside and the substrate; occasionally with lateral branches. Scales scattered over the rhizome but denser on edges and underside; orbicular, 1–1.6 mm diam., with dark centre with thick-walled cells with small lumina and a gradual transition to the narrower marginal cells, margin with scattered glands. Phyllospores solid, not prominent. *Fronds* monomorphic, stalked, deeply pinnatifid; stipe 10–30 cm long, 2–5 mm thick; lamina 30–90 by 10–15 cm, decurrent on the stipe, dark green, coriaceous. Pinnae perpendicular to the rachis or ascending, c. 1 cm wide, narrowed at the base, apex acute to rounded. *Venation* with two rows of areoles with branching recurrent included veinlets. *Sori* 2 mm diam., deeply immersed, in a single row on each side of the costa, forming papillae to 1 mm high on the abaxial surface, to 30 (60) on each pinna. Sporangia 0.3–0.4 mm long, on stalks to 1 mm; spores 16 in each sporangium, to 75 μ m long with filaments to 2 mm long, forming densely tangled packets. — Fig. 10.

Distribution — *Malesia*: Moluccas (Ambon, Seram), New Guinea.

Habitat — Epiphytic in forests. Altitude from sea level (mangrove) to 2000 m.

4. *Lecanopteris sinuosa* (Wall. ex Hook.) Copel.

Lecanopteris sinuosa (Wall. ex Hook.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 123; Hennipman & Verduyn, Blumea 32 (1987) 319; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 301, f. 3. — *Polypodium sinuosum* [Wall., Cat. (1830) n. 2231, nom. nud.] Hook., Sp. Fil. 5 (1864) 61, pl. 284; Baker, Syn. Fil. (1867) 355; Racib., Pterid. Buitenzorg (1898) 103; Alderw., Malayan Ferns (1908) 623, Backer & Posth., Varenfl. Java (1939) 194. — *Pleopeltis sinuosa* Bedd.,

Ferns Brit. India (1866) t. 8; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — *Phymatodes sinuosa* J. Sm., Ferns Brit. & For., ed. 2 (1877) 296. — *Myrmecophila sinuosa* H. Itô, J. Jap. Bot. 11 (1935) 98. — *Myrmecopteris sinuosa* Pichi Serm., Webbia 31 (1977) 240. — Type: Wallich 2231 (K), Malacca.

Rhizome creeping, little to much branched, hollow, 1–2 cm thick, densely covered with scales. Scales orbicular, very unequally sized, to 3.5 mm diam., central cells in the largest scales with large, clear lumina, giving a sharp transition to the narrow marginal cells, forming a distinct dark spot; margin not glandular. Phyllopois hollow, prominent, 1–1.5 cm high. *Fronds* mono- to dimorphic, stalked, simple to sinuate (especially fertile fronds); stipe 3–8 cm long; fertile fronds lamina 15–38 by 1–2 cm, decurrent on the stipe, mid to pale bright green, coriaceous, apex rounded; sterile fronds wider, to 3.5 cm wide. *Venation*: forming a row of areoles with a branching recurrent vein. *Sori* circular to rarely elliptical, 2–5 mm diam., immersed, in a single row on each side of the costa, forming slight projections on the abaxial surface. Sporangia on very short stalks; spores 64, to 48 µm long.

Distribution — Throughout *Malesia*; outside *Malesia*: Indochina, Vanuatu.

Habitat — Epiphytic in various types of lowland evergreen and seasonal forest, particularly in savannah and heath forest, also in disturbed places. Altitude 0–500 m.

5. *Lecanopteris balgooyi* Hennisman

Lecanopteris balgooyi Hennisman, Kew Bull. 41 (1986) 783; Hennisman & Verduyn, Blumea 32 (1987) 315; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 304. — Type: Hennisman 5650 (L; iso BO, K, U), Celebes.

Rhizome much branched, hollow, 2–3 cm thick, forming compact balls to 15 cm across or spirally encircling branches, glabrous or with scattered small brown scales; with spines replacing many of the fronds. Phyllopois hollow, prominent, 6–9 mm high. *Fronds* monomorphic, stalked, entire to pinnatifid; stipe 2–8 cm long, 1–3 mm thick; lamina 15–40 by 2–7 cm, decurrent on the stipe, bright green, chartaceous. Pinnae perpendicular to the rachis or ascending, triangular, up to 3 cm wide at base, apex acute. *Venation* with recurrent freely branching included veins. *Sori* round to elliptic, 2–3 mm diam., sunken, forming pustules to 1 mm high on upper surface, in a single row on each side of the rachis or costae, to 7 on each pinna. Sporangia 0.3–0.4 mm long, on stalks to 0.5 mm long, spores 64, to 65 µm long.

Distribution — *Malesia*: Sulawesi (Central, 2 specimens).

Habitat — High epiphyte in montane forest. Altitude 1000–1150 m.

6. *Lecanopteris carnosa* (Reinw.) Blume

Lecanopteris carnosa (Reinw.) Blume, Enum. Pl. Javae (1828) 120; Fl. Javae Fil. (1851) pl. 94a; Becc., Malesia 2 (1886) 244; Alderw., Malayan Ferns Suppl. (1917) 407; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 29; Hennisman, Kew Bull. 41 (1986) 785; Hennisman & Verduyn, Blumea 32 (1987) 316. — *Onychium carnosum* Reinw., Syllog. Plant. 2 (1824) 3. — *Polypodium lecanopteris* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 224; Alderw., Malayan Ferns (1908) 625. — *Polypodium patelliferum* Burck, Ann. Jard. Bot. Buitenzorg 4 (1884) 96, nom. illeg. — *Pleopeltis carnosa* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — *Polypodium carnosum* H. Christ, Verh. Nat. Ges. Basel 11 (1895) 26, nom. illeg., non *Polypodium carnosum* Mett. nec *P. carnosum* Kellogg. — Type: Reinwardt s.n. (L; iso BM, K, P), Celebes.

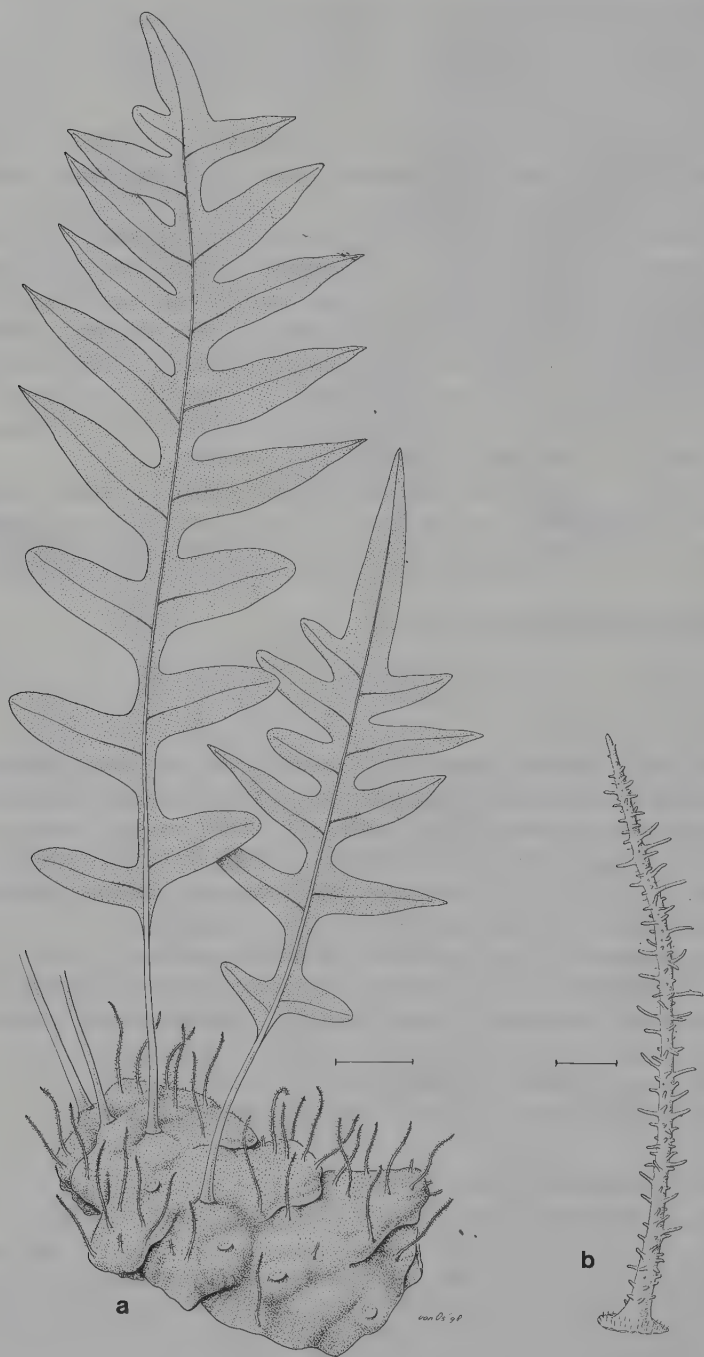


Fig. 11. *Lecanopteris carnosa* (Reinw.) Blume. a. Habit; b. rhizome outgrowth. (De Vogel & Vermeulen 7141). Scale bars: a = 2 cm, b = 2 mm. Drawings by J.H. van Os.

Rhizome much branched, hollow, 1.5–2.5 cm thick, forming a compact clump to 1 m across enclosing branches of trees, covered with branched glandular hairs. Phyllo-pods hollow, prominent, 0.5–1.5 cm high, fronds on some replaced by coralloid out-growths to 2 cm long. *Fronds* (internally) dimorphic, stalked, deeply pinnatifid; stipe 6–20 cm long, to 5 mm thick; lamina 20–70 by 12–20 cm, decurrent on the stipe, mid green, chartaceous. Pinnae slightly ascending, sterile 1.2–2 cm wide, apex acute to rounded, fertile 1–1.5 cm wide, apex acute. *Venation* with recurrent freely branching included veinlets. *Sori* round, deeply immersed, on orbicular marginal lobes, 12–16 on each pinna. Sporangia 0.4–0.5 mm long, on stalks to 0.8 mm long; spores 64, to 80 μ m long. — **Fig. 11.**

Distribution — *Malesia*: Sulawesi (Minahassa).

Habitat — Epiphytic, in montane forest. Altitude from sea level to 1000 m.

7. *Lecanopteris celebica* Hennisman

Lecanopteris celebica Hennisman, Blumea 32 (1987) 316; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 305. — Type: *Hennisman 5665* (L; iso BM, BO, U), Celebes.

Rhizome much branched, hollow, 2.5–3.5 cm thick, forming a compact clump to 50 cm across enclosing branches of trees, covered with simple or branched glandular hairs and scattered scales mainly near apices. *Rhizome scales* brown, deeply dentate. Phyllo-pods hollow, prominent, 1–1.5 cm high, sometimes replaced by solid spines 2–3 mm long. *Fronds* monomorphic, stalked, deeply pinnatifid; stipe 10–20 cm long, 3–5 mm thick; lamina 30–85 by 6–18 cm, decurrent on the stipe, mid green, chartaceous. Pinnae perpendicular to the rachis to ascending, sterile 1–2 cm wide, fertile 0.6–1.2 cm wide, apex rounded. *Venation* with recurrent free veinlets. *Sori* round, 1.5–3 mm diam., immersed in conduplicate marginal teeth, 10–30 on each pinna. Sporangia 0.3–0.5 mm long, on stalks to c. 0.5 mm long; spores 64, to 70 μ m long. — **Fig. 12c.**

Distribution — *Malesia*: Sulawesi (Central, 3 specimens).

Habitat — High epiphyte in montane forest. Altitude c. 1000 m.

8. *Lecanopteris darnaedii* Hennisman

Lecanopteris darnaedii Hennisman, Kew Bull. 41 (1986) 785; Hennisman & Verduyn, Blumea 32 (1987) 317; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 306. — Type: *Hennisman 5322* (L; iso BO, K, U), Celebes.

Rhizome creeping, hollow with a double gallery-system, 3.5–4.5 cm thick, straight or somewhat spirally creeping on trees, densely covered with sharply pointed spines 2–8 mm long. Phyllo-pods solid, not prominent, to 2 mm high. *Fronds* monomorphic, stalked, deeply pinnatifid; stipe 4–15 cm long, 2–5 mm thick; lamina 25–55 by 4.5–7 cm, decurrent on the stipe, dark green, coriaceous, blackish when dried. Pinnae slightly ascending, 0.8–1.6 cm wide, apex rounded. *Venation* with recurrent free veinlets, veins strongly sclerified, prominent, appearing black. *Sori* round, 3 mm diam., immersed in unreflexed marginal lobes, 5–12 on each pinna. Sporangia on stalks c. 0.9 mm long; spores 64, to 65 μ m long. — **Fig. 12a, b.**

Distribution — *Malesia*: Sulawesi (Mt Roroka Timbu, 3 collections).

Habitat — Epiphytic in tree crowns, in upper montane ridge forest. Altitude 2300–2500 m.

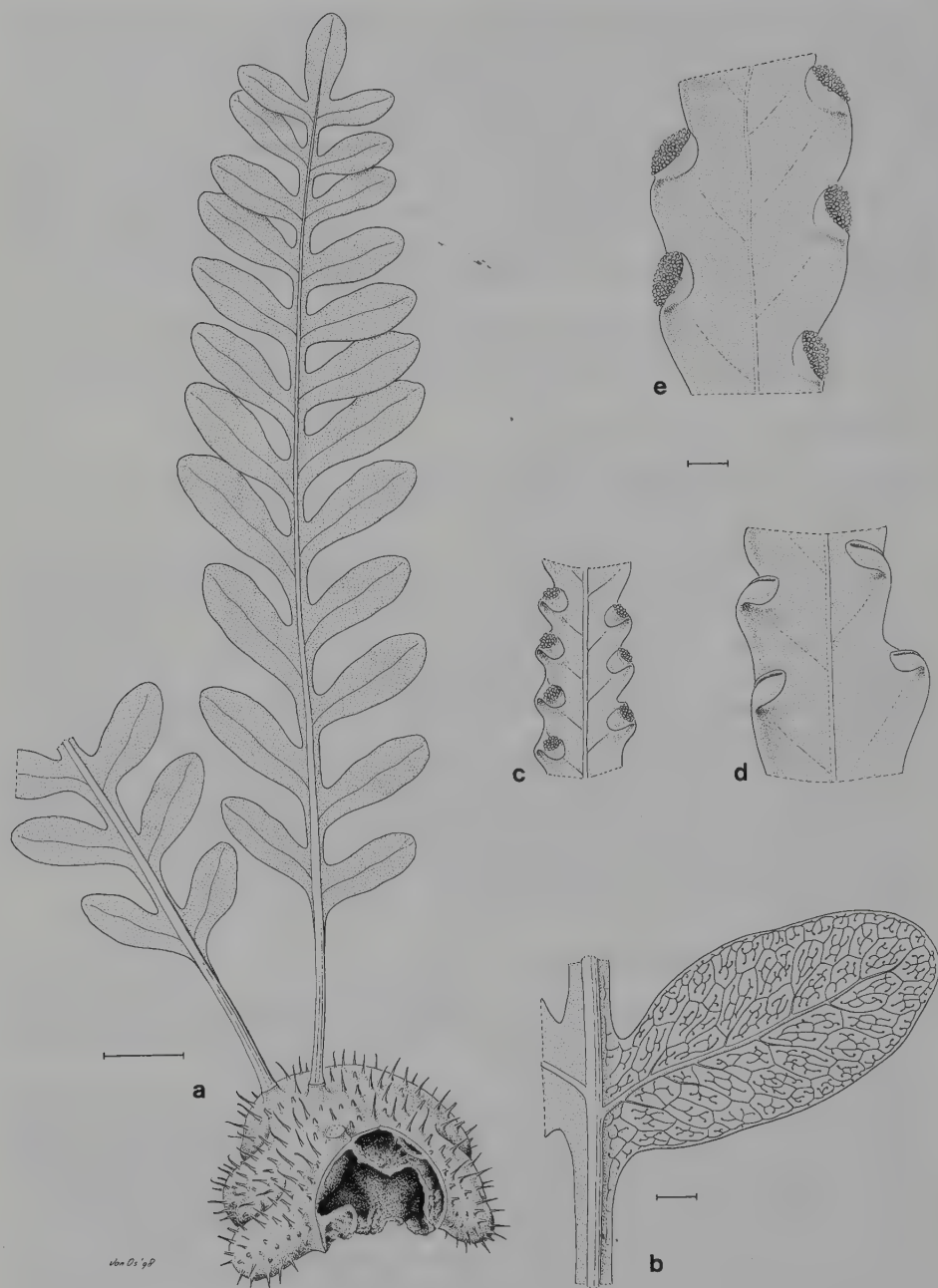


Fig. 12. *Lecanopteris darnaedii* Hennipman. a. Habit; b. venation. — *L. pumila* Blume. c. Sori. — *L. luzonensis* Hennipman. d. Sori. — *L. celebica* Hennipman. e. Sori (a, b: *Darnaedi* 1564; c–e: cultivated specimens in Leiden Botanical Garden). — Scale bars: a = 2 cm, b = 7 mm, c = 6 mm, d, e = 15 mm. Drawings by J.H. van Os.

9. *Lecanopteris deparioides* (Ces.) Baker

Lecanopteris deparioides (Ces.) Baker, J. Bot. 19 n.s., 10 (1881) 366; Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 14; Malayan Ferns Suppl. (1917) 410; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 30. — *Davallia deparioides* Ces., Atti Accad. Sci. Fis. Napoli 7, 8 (1876) 13, pl. 4, f. 8 ('*Cyathea deparioides*'). — *Polypodium deparioides* H. Christ, Farnkr. Erde (1897) 116, nom. illeg., non Baker (1879); Alderw., Malayan Ferns (1908) 626. — *Pleopeltis deparioides* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — Type: *Beccari s.n.*, 1866 (?FI, n.v.), Sarawak.

Lecanopteris curtisii Baker, J. Bot. 19 n.s., 10 (1881) 366; Alderw., Malayan Ferns Suppl. (1917) 409; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 31; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 301, f. 4. — *Pleopeltis curtisii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — *Polypodium naviculare* Alderw., Malayan Ferns (1908) 627, non *Polypodium curtisii* Baker. — Type: *Curtis s.n.* (K), Sumatra.

Lecanopteris macleayi Baker in Becc., Malesia 2 (1886) 244; Alderw., Malayan Ferns Suppl. (1917) 410. — *Polypodium macleayi* Alderw., Malayan Ferns (1908) 626. — *Pleopeltis macleayi* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — Type: *Macleay* (?FI, n.v.), Java.

Lecanopteris incurvata Baker, Ann. Bot. 8 (1894) 123; Alderw., Malayan Ferns Suppl. (1917) 408. — *Polypodium barisanicum* Alderw., Malayan Ferns (1908) 627, nom. nov., non *Polypodium incurvatum* Blume. — *Pleopeltis barisanica* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3, nom. nov., non *Pleopeltis incurvata* T. Moore. — Type: *Hancock* 88 (K), Sumatra.

Lecanopteris philippinensis Alderw., Bull. Jard. Bot. Buitenzorg II, 1 (1911) 8; Malayan Ferns Suppl. (1917) 409. — Type: *Elmer* 10491 (L, K, P), Philippines, Davao.

Lecanopteris davallioides Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 14; Malayan Ferns Suppl. (1917) 409; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 30. — Type: *Teijsmann s.n.* (BO, n.v.), Karimata Island.

Lecanopteris davallioides var. *macrocarpa* Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 14; Malayan Ferns Suppl. (1917) 409. — *Lecanopteris saccata* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 31. — Type: *Ajoeb* 222 (BO, n.v.), Sumatra.

Lecanopteris saccata forma *microcarpa* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 31. — Type: *Lörzing* 4302 (BO, n.v.), Sumatra.

Lecanopteris pumila auct. non Blume: Copel., Fern. Fl. Philipp. 3 (1960) 499.

Lecanopteris carnosa auct. non Blume: Backer & Posth., Varenfl. Java (1939) 237.

Rhizome much branched, hollow, 2–3 cm thick, glaucous, waxy, glabrous except for a scattering of minute scales at the apex. Phyllopois solid, prominent, 1–1.5 cm high. **Fronds** monomorphic to slightly (internally) dimorphic, stalked, deeply pinatifid; stipe 10–25 cm long, 1–2 mm thick, lamina 30–70 by 10–20 cm, not decurrent on the stipe, mid green above, glaucous below, chartaceous. Pinnae perpendicular to the rachis, 0.7–1.1 cm, fertile ones slightly narrowed; apex acute to rounded. **Venation** with recurrent freely branching included veinlets. **Sori** on marginal teeth, immersed in somewhat reflexed, laterally flattened cup-shaped involucre, to 24 on each pinna. Sporangia c. 0.33 mm long, spores 64.

Distribution — *Malesia*: Sumatra, Java, Borneo, Philippines, New Guinea.

Habitat — Epiphytic, in lower montane and mid-montane forest, also in secondary regrowth. Altitude 800–2000 m.

10. *Lecanopteris holttumii* Hennisman

Lecanopteris holttumii Hennisman in Hennisman & Verduin, Blumea 32 (1987) 317; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 307. — Type: *Lack & Grimes* 1743 (K), Celebes.

Rhizome creeping, hollow with a double gallery-system, 3.5–4.5 cm thick, forming clumps to 0.5 m across, densely covered with sharply pointed spines 2–3 mm long. Phyllopods solid, not prominent. *Fronde*s mono- to dimorphic, stalked, deeply pinnatifid; stipe 15–25 cm long, 2–5 mm thick; lamina 15–75 by 3–5 cm, decurrent on the stipe, dark green, coriaceous. Pinnae perpendicular to the rachis, sterile 1–1.5 cm wide, fertile 0.4–0.8 cm wide, apex rounded. *Venation* with recurrent free veinlets, veins hardly sclerified, appearing green. *Sori* round, 3 mm diam., immersed in marginal lobes. Sporangia c. 0.9 mm long; spores 64, to 65 µm long.

Distribution — *Malesia*: Sulawesi (type specimen only).

Habitat — Epiphytic and on rocks on mountain ridge. Altitude c. 2000 m.

11. *Lecanopteris luzonensis* Hennipman

Lecanopteris luzonensis Hennipman, Blumea 32 (1987) 211; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 305. — Type: *Hernandez* (Hennipman 7820) (U; iso PNH), Philippines, Luzon.

Lecanopteris carnosa auct. non (Reinw.) Blume: Holttum, Revis. Fl. Malaya 2 (1955) 210, p.p.; Copel., Fern Fl. Philipp. (1960) 499.

Rhizome much branched, hollow, 1.5–2.5 cm thick, forming flat crusts up to 30 cm across, with irregular, much-branched glandular hairs at the apices, otherwise glabrous. Phyllopods hollow, prominent, 1–1.5 cm high, sometimes replaced by solid spines. *Fronde*s monomorphic, stalked, pinnatifid to 4–5 mm from the rachis; stipe 5–10 cm long, with branched glandular hairs below; lamina 12–45 by 2.5–9 cm, decurrent on the stipe, bright green, chartaceous. Pinnae closely set, often overlapping, 0.7–1.6 cm wide, mostly tapering from near base, apex rounded to acute. *Venation* with recurrent free veinlets. *Sori* elliptic, 1.5–2 mm diam., immersed in laterally flattened, boat-shaped marginal involucre, 5–15 on each pinna. Sporangia c. 0.3 mm long, on stalks c. 0.75 mm long, spores 64, to 65 µm long. — **Fig. 12d, 13.**

Distribution — *Malesia*: Philippines.

Habitat — Medium to high epiphyte, on exposed places in evergreen forest. Altitude 300–1100 m.

12. *Lecanopteris pumila* Blume

Lecanopteris pumila Blume, Fl. Javae Fil. (1851) pl. 94b; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 305. — *Lecanopteris carnosa* var. *pumila* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3; Malayan Ferns Suppl. (1917) 408; Holttum, Revis. Fl. Malaya 2 (1954) 210. — *Polypodium lecanopteris* var. *pumilum* Alderw., Malayan Ferns (1908) 625. — Type: Blume, l.c.: pl. 94b.

Lecanopteris nieuwenhuisenii H. Christ, Ann. Jard. Bot. Buitenzorg 20 (1899) 127; Alderw., Malayan Ferns Suppl. (1917) 408. — *Polypodium nieuwenhuisenii* Alderw., Malayan Ferns (1908) 626. — *Pleopeltis nieuwenhuisenii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — Type: *Nieuwenhuisen* 496 (K), Borneo.

Rhizome much branched, hollow, 1.5–2.5 cm thick, covered with scattered scales and simple or sometimes branched glandular hairs. *Rhizome scales* small, dark, dentate. Phyllopods hollow, prominent, 1–1.5 cm high, sometimes replaced by solid spines. *Fronde*s monomorphic, stalked, deeply pinnatifid to the rachis; stipe 7–10 cm long, 2–5 mm thick, glabrous; lamina 20–40 by 4–6 cm, decurrent on the stipe, bright

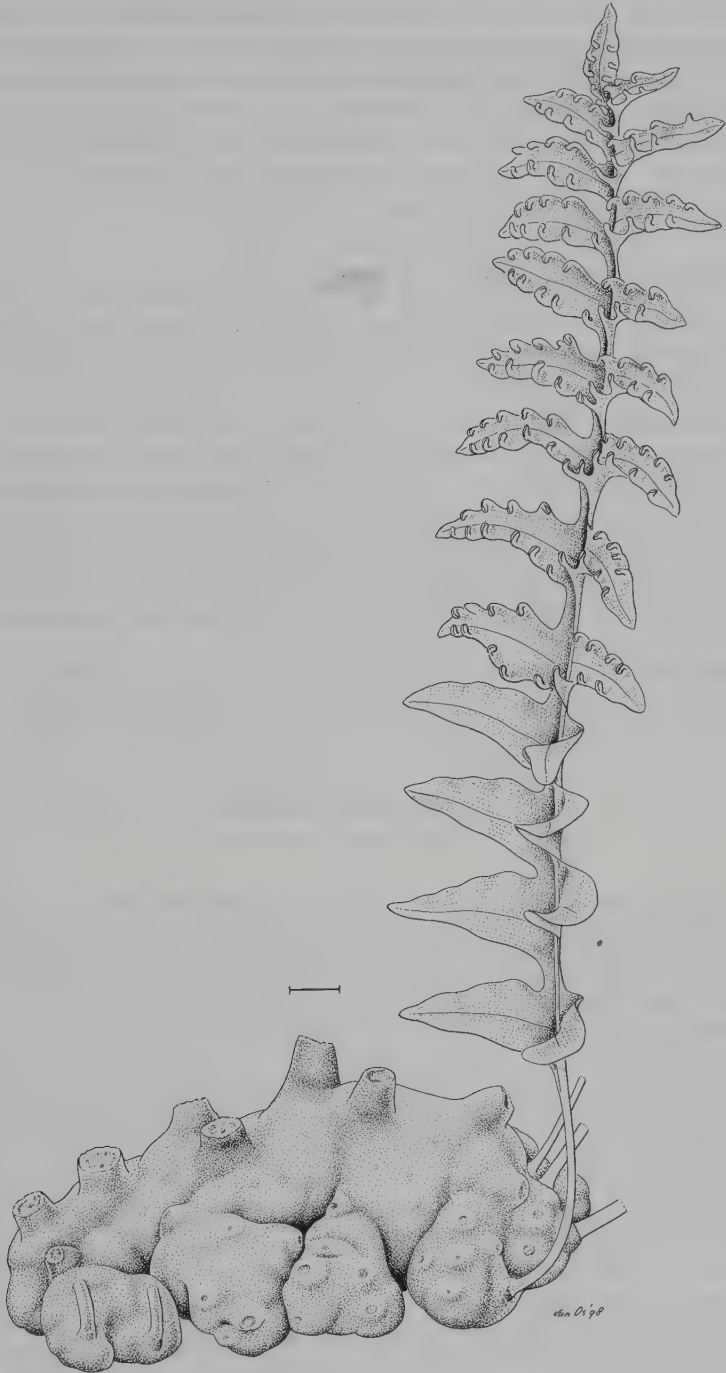


Fig. 13. *Lecanopteris luzonensis* Hennisman. Habit (a cultivated specimen in Leiden Botanical Garden). Scale bar = 1 cm. Drawing by J. H. van Os.

green, chartaceous. Pinnae obovate, 0.7–1 cm wide, narrowed at their base, equally wide to near apex, apex rounded to acute. *Venation* with recurrent free veinlets. *Sori* round, 2–3 mm diam., deeply immersed in orbicular cup-shaped reflexed marginal involucre, 12–15 on each pinna. Sporangia c. 0.3 mm long; on stalks to 0.5 mm long. — **Fig. 12c.**

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Borneo.

Habitat — Epiphytic, in mid-montane and ridgetop forest.

13. *Lecanopteris spinosa* Jermy & Walker

Lecanopteris spinosa Jermy & Walker, Fern. Gaz. 11 (1975) 167; Hennipman, Kew Bull. 41 (1986) 787; Hennipman & Verduyn, Blumea 32 (1987) 318; H.E. Gay et al., Gard. Bull. Sing. 45 ('1993', 1994) 306. — Type: *Jermy 7609* (BM; iso BO, GH, L), Celebes.

Rhizome much branched, hollow, 2.5–3.5 cm thick, forming clusters up to 25 cm across, densely covered with pointed spines up to 6 mm long. Phylloids not prominent. *Fronds* mono- to dimorphic, stalked. Sterile fronds simple, fertile deeply lobed; stipe 10–20 cm long, 2–5 mm thick; lamina 24–90 by 3–4 cm, decurrent on the stipe, mid-green, chartaceous. *Venation* with recurrent free veinlets. *Sori* round, 2–5 mm diam., deeply immersed on the lamina in one row on each side of the rachis in the upper 2/3 of the lamina. Sporangia on stalks to c. 0.8 mm long; spores 64, to 70 µm long.

Distribution — *Malesia*: Sulawesi (Latimojong Mts, 2 coll.).

Habitat — High epiphyte in upper montane forest. Altitude c. 1950 m.

LEMMAPHYLLUM

(P.H. Hovenkamp)

Lemmaphyllum C. Presl, Epim. Bot. (1851) 157; C. Chr., Dansk Bot. Ark. 6 (1929) 44; Copel., Gen. Fil. (1947) 189; Holttum, Revis. Fl. Malaya 2 (1955) 152; Donk, Reinwardtia 2 (1954) 403; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 215. — Type species: *Lemmaphyllum spatulatum* (Donk l.c.: 405; = *Lemmaphyllum carnosum*).

Weatherbeya Copel., Gen. Fil. (1947) 191, pl. 6. — Type species *Weatherbeya accedens* [= *Lemmaphyllum accedens* (Blume) Copel.].

Epiphytic small ferns. *Rhizome* long-creeping, filiform, and sparsely covered with scales, dorsally with 2 rows of fronds, sparsely set with roots, without or with a few scattered sclerenchyma strands. *Rhizome scales* basifixed, peltate, ovate to narrowly ovate, clathrate, dentate to lacerate. *Fronds* simple, mono- to dimorphic, entire, stipitate. Lamina more or less succulent, glabrous or with sparse, deciduous scales. *Venation*: midrib usually distinct, veins indistinct, forming 2 or 3 rows of areoles, mostly with included, forked, recurrent free veinlets. *Sori* round to elliptic or forming longitudinal coenosori, covered with deciduous peltate scale-like paraphyses when young. Receptacular paraphyses filiform, basifixed or peltate, clathrate, mostly deciduous. — **Fig. 14.**

Distribution — Widespread throughout Southeast Asia, from the Himalayas to Japan, throughout *Malesia*.

Taxonomy — The presence of both separate sori and coenosori in this genus has induced Ching to distinguish *Lepidogrammitis*, and Copeland (1947) to distinguish *Weatherbeya*. However, taken over the entire range of *Lemmaphyllum*, the forms with different types of sori can be seen to grade into each other imperceptibly. *Lemmaphyllum* is closely related to *Lepisorus*, from which it differs mainly in the filiform, creeping rhizome and the tendency to form coenosori.

KEY TO THE SPECIES

- 1a. Sporangia in longitudinal coenosori **2a. *L. carnosum* var. *carnosum***
- b. Sporangia in separate, round sori **2**
- 2a. Fertile lamina narrowed, usually forming a more or less distinct 'spike' **1. *L. accedens***
- b. Fertile lamina not narrowed **2b. *L. carnosum* var. *rostratum***

1. *Lemmaphyllum accedens* (Blume) Donk

Lemmaphyllum accedens (Blume) Donk, Reinwardtia 2 (1954) 409; Holttum, Revis. Fl. Malaya 2 (1955) 152; Tagawa & Iwats. in Fl. Thailand 3, 4 (1989) 516. — *Polypodium accedens* Blume, Enum. Pl. Javae (1828) 121; Hook., Sp. Fil. 5 (1864) 66; Baker, Syn. Fil. (1867) 353; Racib., Pterid. Buitenzorg (1898) 103; Alderw., Malayan Ferns (1908) 633. — *Pleopeltis accedens* T. Moore, Index Filic. (1857) 77; Bedd., Ferns Brit. India (1866) t. 215; Handb. Ferns Brit. India, Suppl. (1892) 345. — *Phymatopsis accedens* J. Sm., Hist. Fil. (1875) 104. — *Microsorium accedens* Copel., Univ. Calif. Publ. Bot. 16 (1929) 112. — *Lepisorus accedens* Hosokawa, Trans. Nat. Hist. Soc. Formosa 31 (1941) 477. — *Weatherbeya accedens* Copel., Gen. Fil. (1947) 191, pl. 6; Fern Fl. Philipp. (1960) 466. — Type: *Blume s. n.* (L, BM), Java.

Polypodium damunense Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 5 (1908) 42; Alderw., Malayan Ferns (1908) 634. — *Pleopeltis damunensis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — *Weatherbeya damunensis* Copel., Gen. Fil. (1947) 191. — Type: *Werner 63* (L), New Guinea.

Small fern. *Rhizome* to 1.1 mm thick, long-creeping, internodes 1.5–4 cm long, sparsely covered with scales. *Anatomy*: ground tissue parenchymatous, sclerenchyma strands few, vascular strands 3–7. *Rhizome scales* to 4.4 by 1.6 mm, base dentate or sometimes lacerate, acumen gradually narrowed, dentate, apex acute, sometimes filiform. *Fronds* mono- to dimorphic, sparsely covered with deciduous clathrate scales. *Sterile fronds*: stipe absent or to 0.7 cm long, lamina to 10 by 2.7 cm, orbicular to ovate, rarely obovate, margin entire, apex rounded to acute. *Fertile fronds* to 17.5 by 1.8 mm, ovate to elliptic, fertile in the, mostly contracted, upper part. *Sori* round to elliptic, medially between costa and margin in contracted parts of the frond, more marginal in wider parts.

Distribution — Throughout *Malesia*. Outside *Malesia*: Solomon Islands, Admiralty Islands, Fiji, Samoa.

Habitat — Epiphytic.

Note — *Polypodium damunense* represents a small, much more strongly dimorphic form, in the most typical form restricted to New Guinea, but scattered elsewhere (Java, Sulawesi) specimens occur which show all transitions to normal *L. accedens*. It is not an altitudinal form, being found at altitudes up to c. 500 m. This range overlaps with that of normal *L. accedens*, which, however, has a distinct preference for



Fig. 14. *Lemmaphyllum carnosum* (Hook.) C. Presl var. *rostratum* Hook. a. Habit. — *L. carnosum* var. *carnosum*. b. Fertile frond; c. sterile fronds (a: *de Wilde & de Wilde-Duyffes* 13702; c, d: *Copeland* 1840). — Scale bar for a = 1 cm, for b & c = 5 mm. Drawings by J. H. van Os.

higher altitudes, and is usually better developed over 1000 m. Most of the transitional specimens are from lower altitudes, although normal forms may also occur at sea level. There is a curious parallel pattern of variation in *Pyrrosia foveolata* and *P. foveolata* var. *lauterbachii*.

2. *Lemmaphyllum carnosum* (Hook.) C. Presl

- Lemmaphyllum carnosum* (Hook.) C. Presl, Epim. Bot. (1851) 158; Ching, Sunyatsenia 5 (1940) 259; Copel., Gen. Fil. (1947) 189; Tagawa & Iwats. in Fl. Thailand 3, 4 (1989) 518. — *Drymoglossum carnosum* Hook., Gen. Fil. (1842) pl. 78A; Baker, Syn. Fil. (1867) 397, excl. syn.; Bedd., Ferns Brit. India (1866) t. 40; Alderw., Malayan Ferns (1908) 702. — [*Notochlaena carnosum* Wall., Cat. (1829) n. 138, nom. nud.] — *Taenitis carnosus* Mett., Fil. Hort. Bot. Lips. (1856) 28. — *Elaphoglossum carnosum* Keyserl., Polyp. Cyath. Herb. Bunge (1873) 36. — *Oetosis carnosus* Kuntze, Rev. Gen. Pl. 2 (1891) 817. — *Drymoglossum subcordatum* var. *carnosum* H. Christ in Warb., Monsunia 1 (1900) 66. — Type: Wallich 138 (BM, US), Nepal.
- Lemmaphyllum microphyllum* C. Presl, Epim. Bot. (1851) 263; C. Chr., Dansk Bot. Ark. 6 (1929) 46; Copel., Gen. Fil. (1947) 189; Shieh, De Vol & Kuo in Fl. Taiwan, ed. 2, 1 (1994) 487. — *Taenitis microphylla* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 173. — *Drymoglossum microphyllum* C. Chr., Index Filic. (1906) 246; C. Chr., Dansk Bot. Ark. 6 (1929) 46. — Type: von Siebold s.n. (L, PRC), Japan.
- Drymoglossum spatulatum* [C. Presl, Tent. Pterid. (1836) 227, nom. nud.] Copel., Polypod. Philipp. (1905) 112; Fern Fl. Philipp. (1960) 465. — *Lemmaphyllum spatulatum* C. Presl, Epim. Bot. (1851) 158; Copel., Gen. Fil. (1947) 189. — Type: Meyen s.n. (PRC), Philippines, Luzon.
- Drymoglossum subcordatum* Fée, Gen. Filic. (1850-1852) 29. — Syntypes: Labillardière s.n., Gaudichaud s.n. (both P, n.v.).
- Drymoglossum carnosum* var. *obovatum* Harr., J. Linn. Soc. Bot. 16 (1877) 33. — *Drymoglossum obovatum* H. Christ, J. Bot (Morot) (1905) 73; C. Chr., Dansk Bot. Ark. 6 (1929) 47. — *Lemmaphyllum microphyllum* var. *obovatum* C. Chr., Dansk Bot. Ark. 6 (1929) 47; Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 102. — Type: Steere 487 (GH, MICH), Taiwan.

a. var. *carnosum*

Rhizome 0.6–1.1 mm thick, long-creeping, internodes 1.5–3 cm long, sparsely covered with more or less deciduous scales. Anatomy: ground tissue parenchymatous, sclerenchyma strands absent or few, vascular strands 4–6, with or without sclerified bundle sheath. *Rhizome scales* to 2.1 by 1.1 mm, lacerate at base, acumen gradually narrowed or more or less abruptly contracted above the base, margin dentate, apex acute, sometimes filiform. *Fronds* dimorphic, glabrous. Sterile fronds: stipe short or to 2 cm long, lamina 1–6.5 by 1–2.5 cm, ovate to lanceolate, margin entire, slightly recurved, apex obtuse to apiculate. Fertile fronds with stipe 4–6 cm long, to 10 by 0.2–0.3 cm, linear. *Sori* forming longitudinal, sometimes interrupted, coenosori. —

Fig. 14b, c.

Distribution — *Malesia*: Philippines (Luzon).

Habitat — Epiphytic. Altitude to 2250 m.

Notes — 1. Outside Malesia this species is widely distributed and very variable. Within Malesia it occurs in two widely distant small areas, in two distinct forms, usually regarded as distinct species. The intermediate forms however, although absent in Malesia, are the reason that a distinction at a lower level is more appropriate.

2. This species has also been reported from Ambon in the Moluccas, but no specimens could be located in BO to document that occurrence.

b. var. *rostratum* Hook.

Polypodium rostratum Hook., Icon. Pl. (1854) t. 953, nom. illeg., non Burm. f. (1768) nec Cav. (1802); Hook., Sp. Fil. 5 (1864) 66; Baker, Syn. Fil. (1867) 353. — *Pleopeltis rostrata* Bedd., Ferns Brit. India (1866) t. 159; Handb. Ferns Brit. India (1883) 344. — *Phymatopsis rostrata* J. Sm., Hist. Fil. (1875) 104. — *Polypodium subrostratum* C. Chr., Index Filic. (1906) 567. — *Lemmaphyllum subrostratum* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 97, nom. superfl.; Tagawa, Acta Phytotax. Geobot. 5 (1936) 112. — *Lepisorus subrostratus* C. Chr. & Tardieu, Notul. Syst. 8 (1939) 187, nom. superfl. — *Lepidogrammitis subrostrata* Ching, Sunyatsenia 5 (1940) 258, nom. superfl. — *Lemmaphyllum rostratum* Tagawa in Hara, Fl. E. Himal. (1966) 493. — *Lepidogrammitis rostrata* Ching, Acta Phytotax. Sin. 9 (1964) 372. — Type: *Hooker & Thomson s.n.* (K, n.v.; W), Khasya.

Rhizome 0.8–1.3 mm thick, rhizome scales to 3.6 by 1.3 mm. *Fronds* weakly dimorphic, sterile fronds 6–10 by 2–2.5 cm, fertile fronds with 4 or 5 separate, round sori on each side of the midrib, at 2.5–5 mm from the midrib. — **Fig. 14a.**

Distribution — *Malesia*: N Sumatra.

Habitat — Epiphytic in mossy forest. Altitude 1500–1900 m.

LEPISORUS

(P.H. Hovenkamp)

Lepisorus Ching, Bull. Fan Mem. Inst. 4 (1933) 47; Holttum, Revis. Fl. Malaya 2 (1955) 151; Hovenkamp, Blumea 43 (1998) 109. — *Drynaria* * *Lepisorus* J. Sm., Bot. Mag. 12 Comp. (1846) 13; Hist. Fil. (1875) 113, as section. — Type species: *Lepisorus nudus* (Hook.) Ching. *Paragramma* T. Moore, Index Filic. (1857) 32; Copel., Gen. Fil. (1947) 190; Fern Fl. Philipp. (1960) 465; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 217. — Type species: *Grammitis longifolia* Blume (= *Lepisorus longifolius*). *Pleopeltis* auct. non Humb. & Bonpl. ex Willd.: Copel., Fern Fl. Philipp. (1960) 463.

Epiphytic, sometimes terrestrial, medium-sized ferns. *Rhizome* short- to long-creeping, approximately terete, covered with scales, dorsally with 2 rows of fronds, sparsely to densely set with roots, dictyostelic, with or without scattered sclerenchyma strands. *Rhizome scales* basifixed, pseudopeltate, ovate to linear-lanceolate, fully clathrate or with a membranaceous margin, reddish to brown, entire to dentate, sometimes with a tuft of hairs near the point of attachment. *Fronds* simple, entire, stipitate. Lamina narrowly ovate to linear, the base narrowly cuneate to truncate, the apex rounded, acute or acuminate, olivaceous to brown when dry, dull, pergamentaceous or chartaceous, glabrous or thinly covered with scattered clathrate scales. *Venation*: the midrib distinct, main veins distinct halfway to the margin or indistinct, anastomosing and forming irregular areoles with many free veinlets, free veinlets excurrent and recurrent, immersed. *Sori* in a single row between midrib and margin, round or sometimes elongated, 2–10 by 2–6 mm, densely covered with more or less persistent clathrate scales when young. Sporangia stalked, with 13–16 indurated annulus cells, mixed with peltate or basally attached paraphyses. Spores monolet, rugulate. — **Fig. 15.**

Distribution — Tropical Africa and Asia, extending to Korea and Japan, throughout *Malesia*, also in Hawaii.

Taxonomy — Two of the three Malesian species have been assigned to *Paragramma*, but the basis for a generic separation of *Paragramma* is weak. In all characters studied so far, *Paragramma* falls within the range encountered in *Lepisorus*.

Lepisorus is close to *Belvisia* and *Lemmaphyllum*. The three genera are included in the tribe *Lepisoreae* by Hennipman et al. (1990); their distinction has been discussed by Hovenkamp & Franken (1993). Hennipman et al. (l.c.) distinguish the *Lepisoreae* from the *Microsoreae* mainly on the basis of characters of spore ultrastructure. Morphologically, the delimitation from *Microsorium* can only be made on the basis of a combination of characters: fronds simple (simple or divided in *Microsoreae*), sori in a single row between midrib and margin (one to several rows in *Microsoreae*), covered with peltate paraphyses at least when young (mostly glabrous in *Microsoreae*). *Lepisorus* has often been confused with the mainly Neotropical *Pleopeltis* (e.g., Copeland 1947, 1960), but can easily be distinguished by the constant presence of sclerenchyma in the rhizome (Zink 1993).

References: Copeland, E.B., *Genera Filicum* (1947); Fern Flora of the Philippines (1960). — Hennipman, E., P. Veldhoen & K.U. Kramer, in K.U. Kramer & P.S. Green, *The families and genera of vascular plants* (1990) 203–214. — Hovenkamp, P.H. & N.A.P. Franken, *An account of the fern genus Belvisia Mirbel (Plypodiaceae)*. *Blumea* 37 (1993) 505–524. — Zink, M. 1993. *Systematics of the fern genus Lepisorus (J. Smith) Ching (Polypodiaceae-Lepisoreae)*. Thesis, Zurich.

KEY TO THE SPECIES

- 1a. Sori marginal **2. L. longifolius**
- b. Sori costal to medial **2**
- 2a. Rhizome scales with a central band of dark, thick-walled cells, 1–1.5 mm wide ..
- **4. L. thunbergianus**
- b. Rhizome scales clathrate with thin-walled cells throughout, 2–4 mm wide .. **3**
- 3a. Rhizome short-creeping, fronds close together, long, strap-shaped
- **1. L. balteiformis**
- b. Rhizome long-creeping, fronds remote, narrowly ovate-lanceolate **3. L. mamas**

1. *Lepisorus balteiformis* (Brause) Hovenkamp

Lepisorus balteiformis (Brause) Hovenkamp, *Blumea* 43 (1998) 110. — *Polypodium balteiforme* Brause, *Bot. Jahrb. Syst.* 56 (1920) 194. — *Paragramma balteiformis* Copel., *Gen. Fil.* (1947) 190. — Type: *Ledermann 10979* (B; iso BM, fragment), New Guinea.

Rhizome 4–8 mm thick, not glaucous, brownish when dry, shortly creeping, phyllo-pods raised, 1.5–2 cm distant. **Anatomy:** vascular strands c. 12, without sclerified bundle sheaths, sclerenchyma strands absent, ground tissue not sclerified or with some erratic sclerification. **Rhizome scales** pseudopeltate, appressed, 6.5–8 by 2 mm, clathrate, margin regularly dentate, apex acute. **Fronds** not or very shortly stipitate, stipe to c. 0.7 cm; lamina to 150 by 1.5–3.3 cm, papyraceous, strap-shaped or widest at 1/3–1/2 its length, at base very gradually narrowed to a short truncate base, apex rounded to acute, margin flat or very slightly incurved; costa sparsely set with dark clathrate, dentate, elongate scales, similar but smaller scales sparsely scattered over the lower surface of the lamina. **Venation** usually quite visible, main veins indistinct,

all veins forming a mesh of areoles. Free veinlets many, recurrent and excurrent. Hydathodes present, superficial. *Sori* round or slightly elongated transversely, to 6 by 4 mm, impressed, densely covered with scales when young, in a single row close to or up to 2 mm from the costa. Sporangia long-stalked, capsules c. 0.4 mm long, with 14 or 15 indurated annulus cells. Soral scales of two types: dark, peltate, round, irregularly dentate clathrate scales to 0.5 mm diam., deciduous or remaining as a dark ring around the ripe sorus; and brown, irregularly branched scale-like hairs remaining between the old sporangia. Spores hyaline, c. 70 by 50 μm , coarsely verrucate.

Distribution — *Malesia*: New Guinea.

Habitat — Epiphytic, in forest, on *Pandanus* in gullies, crown epiphyte. Altitude 1550–2200 m.

2. *Lepisorus longifolius* (Blume) Holttum

Lepisorus longifolius (Blume) Holttum, Revis. Fl. Malaya 2 (1955) 151; Tagawa & Iwats. in Fl. Thailand 3, 4 (1989) 508; Hovenkamp, Blumea 43 (1998) 111. — *Grammitis longifolia* Blume, Enum. Pl. Javae (1828) 119. — *Pleopeltis longifolia* Blume, Enum. Pl. Javae (1828) Addenda et emendanda. — *Polypodium longifolium* Hook., Ic. Plant. (1854) 987; Mett., Farngett. I. Polypodium (1856) 87, pl. 1, f. 46; Hook., Sp. Fil. 5 (1864) 60; Baker, Syn. Fil. (1867) 355. — *Paragramma longifolia* (Blume) T. Moore, Index Filic. (1857) 32; (1860) pl. 19b; Copel., Gen. Fil. (1947) 190; Fern Fl. Philipp. (1960) 465. — *Pleopeltis longifolia* Bedd., Ferns Brit. India (1866) t. 6; Handb. Ferns Brit. India (1883) 349. — *Phymatodes longifolia* J. Sm., Cat. Cult. Ferns (1857) 9. — *Nipholobolus longifolius* Keyserl., Polyp. Cyath. Herb. Bunge (1873) 38, non Spreng. (1827). — Type: *Blume s.n.* (L), Java.

Grammitis decurrens Blume, Enum. Pl. Javae (1828) 119. — *Pleopeltis decurrens* Blume, Enum. Pl. Javae (1828) Addenda et emendanda. — *Polypodium decurrens* Kunze, Bot. Zeitung (Berlin) 4 (1846) 421, nom. illeg., non Raddi (1819). — *Paragramma decurrens* T. Moore, Index Filic. (1857) 32. — Type: *Blume s.n.* (L), Java.

[*Polypodium contiguum* Wall., Cat. (1829) 285, nom. nud. — *Drynaria revoluta* J. Sm., J. Bot. (Hook.) 3 (1841) 421, nom. nud.] — *Polypodium contiguum* Hook., Ic. Plant. 10 (1854) pl. 987; Century of Ferns (1854) pl. 87; non Brackenr. (1854). — *Polypodium revolutum* C. Chr., Index Filic. (1906) 331, 559; Alderw., Malayan Ferns (1908) 638; Backer & Posth., Varenfl. Java (1939) 195. — *Pleopeltis revoluta* Alderw., Bull. Dép. Agric. Indes Néerl. 23 (1909) 5. — *Phymatodes revoluta* Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 468 (ascribed to T. Moore). — Syntypes: *Wallich* 285, *Griffith s.n.*, *Cuming* 247; *Low s.n.*, *Fortune* 21.

Polypodium productum H. Christ, Philipp. J. Sc., Bot. 2 (1907) 178. — Type: *Copeland* 1585 (MICH), Philippines, Mindanao.

Rhizome 3–4.5 mm thick, often slightly glaucous, ascending to short-creeping, phylloids raised, contiguous or very short-spaced. Anatomy: vascular strands to 18, without sclerified bundle sheaths, sclerenchyma strands many, scattered, smaller towards the periphery, ground tissue not sclerified. *Rhizome scales* appressed, 3.5–4 by 1 mm, clathrate, often somewhat parenchymatous near the attachment, superficially set with long unicellular hairs, margin irregularly coarsely dentate, apex acute. *Fronds* stipitate; stipe to 8 cm long, not distinctly delimited from the narrowed lamina base, lamina to 70 by 1–4.5 cm, chartaceous, glabrous, strap-shaped or widest at 1/3–1/2 its length, base very gradually narrowed into the stipe, rounded to acute, margin often incurved. *Venation*: veins immersed in the lamina, main veins indistinct, all veins forming a mesh of areoles. Free veinlets many, recurrent and excurrent. Hydathodes absent. *Sori* round or elongated longitudinally, to 10 by 2 mm, sunken, densely cov-

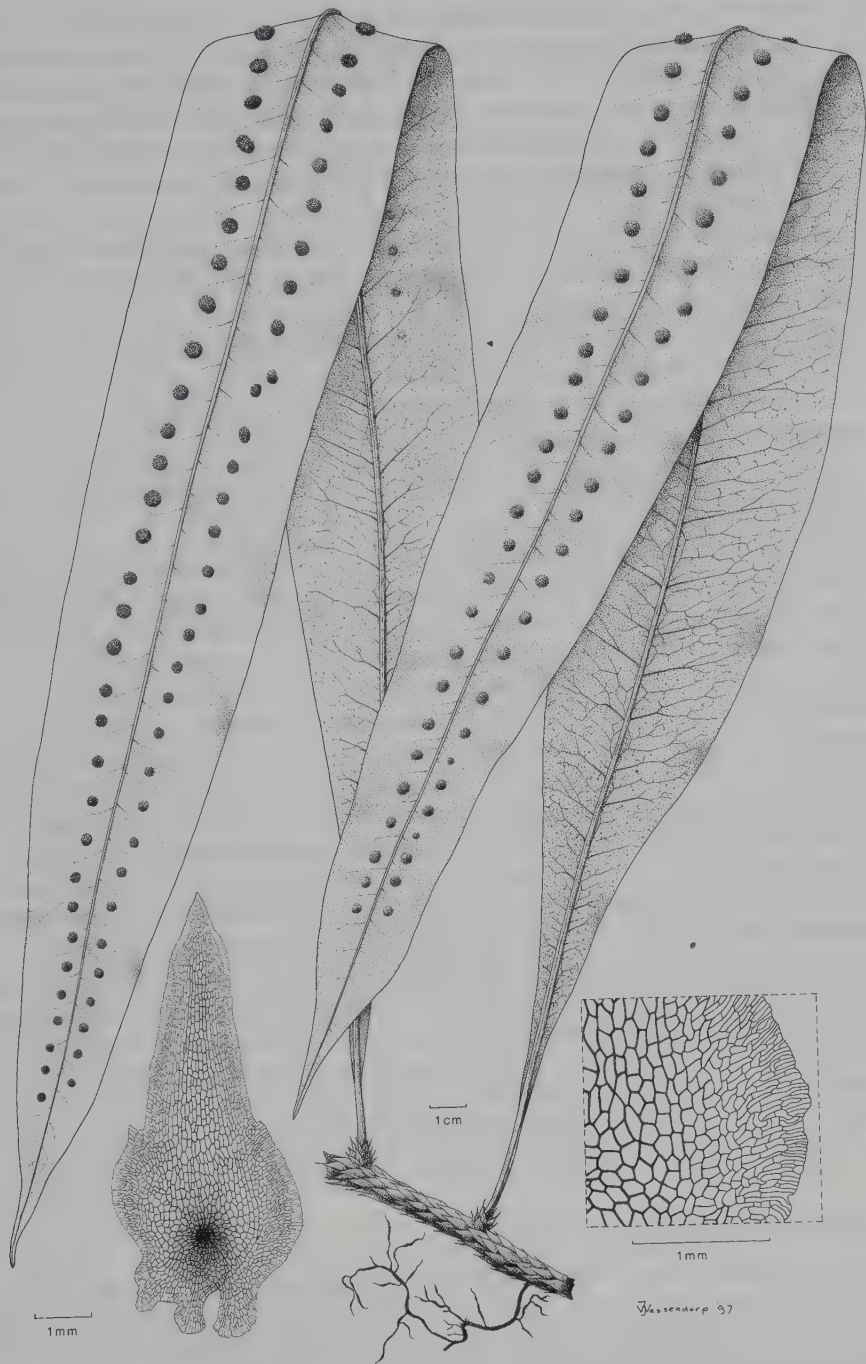


Fig. 15. *Lepisorus mamas* Hovenkamp. a. Habit; b, c: rhizome scale (a: de Wilde & de Wilde Duyfjes 15812, b, c: de Wilde & de Wilde-Duyfjes 13050). Drawing by J. Wessendorp. Reproduced from Blumea 43 (1998).

ered with scales when young, in a single row at 1–2 mm from the margin, margin often incurved over the sori. Sporangia long-stalked, capsules c. 0.3 mm long, with 13 or 14 indurated annulus cells. Soral scales of two types: dark, peltate, round, entire, clathrate scales to 0.3 mm diam., deciduous or remaining as a dark ring around the ripe sorus; and brown, irregularly shaped, mostly basifixed scales with irregularly thickened cell walls, remaining between the old sporangia. Spores hyaline, c. 50–60 by 35 μm , verrucate.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia (extending to southern Thailand), Borneo, Philippines, Java, Sulawesi. Outside *Malesia*: Mergui; Himalayas?; Vietnam.

Habitat — Low to high epiphytic in various types of forest, rarely terrestrial, in humus. Altitude from sea level to 800–1350 m.

3. *Lepisorus mamas* Hovenkamp

Lepisorus mamas Hovenkamp, *Blumea* 43 (1998) 112, f. 1. — Type: *de Wilde & de Wilde-Duyffes* 15812 (L), Sumatra.

Rhizome 6–7 mm thick, not or slightly glaucous, blackish when dry, medium to long-creeping, internodes 1.5–6 cm long, sometimes irregularly longer, branches arising about halfway along the internodes. Anatomy: vascular strands 16–19, without sclerified bundle sheaths, sclerenchyma strands 30–50, scattered, ground tissue not sclerified. *Rhizome scales* pseudopeltate, appressed, 7–8.5 by 2–4 mm, widest slightly above the point of attachment, clathrate with a narrow flabelloid margin of non-clathrate cells, light brown, dull to light iridescent, entire, apex obtuse to acute. *Fronde* stipitate; stipe 1–3.5 cm long, lamina to 62 by 6.5 cm or longer, widest at 1/3–1/2 its length, base narrowly acuminate, apex acute to slightly acuminate, glabrous or with very few, scattered, small, round, clathrate scales. *Venation*: main veins not visible or indistinct, running to halfway the margin or less, then splitting and disappearing in a mesh of areoles. Free veinlets many, recurrent and excurrent, ending in hydathodes. Hydathodes present. *Sori* to 5 mm wide, sometimes elongated longitudinally, in a single row at about 1/3 between midrib and margin, superficial, sometimes confluent across the veins, densely covered with scales when young. Sporangia stalk-ed, capsules c. 0.3 mm long, with 13–16 indurated annulus cells. Soral scales round, peltate, clathrate, to 0.7 mm diameter. Spores hyaline, 58–62 by c. 40 μm . — **Fig. 15.**

Distribution — *Malesia*: Sumatra.

Habitat — Open forest or cleared places, epiphytic on trunks or stumps, also terrestrial. Altitude 1600–1800 m.

4. *Lepisorus thunbergianus* (Kaulf.) Ching

Lepisorus thunbergianus (Kaulf.) Ching, *Bull. Fan Mem. Inst. Biol. Bot.* 4 (1933) 88; Tardieu & C. Chr. in *Fl. Indo-Chine* 7, 2 (1941) 458; De Vol & Kuo in *Fl. Taiwan* 1 [Pterid.] (1975) 188; W.C. Shieh et al., *Fl. Taiwan* 1, ed. 2 (1994) 493; Hovenkamp, *Blumea* 43 (1998) 114. — *Polypodium lineare* Thunb. ex Murray, *Syst. Veg.* ed. 14 (1784) 934, nom. illeg., non. *Burm. f.* (1768). — *Pleopeltis thunbergiana* Kaulf., *Wesen Farnkr.* (1827) 113; Copel., *Fern Fl. Philipp.* (1960) 463. — *Polypodium thunbergianum* C. Chr., *Ind. Fil. Suppl.* 3 (1934) 160. — Type: *Kosido s. n.* (UPS, Herb. Thunberg), Japan.

Rhizome 1–1.5 mm thick, not glaucous, brownish when dry, short-creeping, phylloids nearly contiguous (internodes rarely to 1 cm long in material from other locations). Anatomy: vascular strands c. 6, without sclerified bundle sheaths, sclerenchyma strands 5–15, scattered, ground tissue not sclerified. *Rhizome scales* peltate, slightly spreading, 1–1.5 by 2–3 mm, widest near the point of attachment, clathrate with a central band of dark thick-walled, opaque cells, margin irregularly dentate, apex acute. *Fronde* monomorphic, indistinctly stipitate; stipe to 1 cm long, lamina 5–13 by 0.5–1 cm (dry), widest at 1/3–1/2 its length, base very narrowly acuminate, apex acute to somewhat apiculate, glabrous or with few, small, deltoid, clathrate scales near the base of the costa on the lower surface. *Venation*: completely hidden. Hydathodes present. *Sori* mostly slightly elongated longitudinally, to 4 by 2.5 mm, in a single row halfway between midrib and margin, sometimes protruding when old, superficial, densely covered with scales when young. Sporangia stalked, capsules c. 0.3 mm long, with 14–16 indurated annulus cells. Soral scales round, peltate, clathrate, to 0.5 mm diam. Spores hyaline, 68–74 by 40–48 μm , coarsely verrucate.

Distribution — Probably widespread from the Himalayas throughout Southeast Asia to Japan and Hawaii [Zink, Thesis Zurich (1993) 96]. In *Malesia*: Philippines (northern Luzon).

Habitat — On rocks in pine wood. Altitude 1800–2100 m.

LEPTOCHILUS

(H.P. Nootboom)

Leptochilus Kaulf., Enum. Filic. (1824) 147; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 219; Noot., Blumea 42 (1997) 274. — Type species: *Leptochilus axillaris* Kaulf.

Grammitis Hook. & Grev., Icon. Filic. (1827) t. 6. — *Grammitis* sect. *Diagramma* Blume, Enum. Pl. Javae (1828) 118, p.p. — *Selliguea* Blume, Enum. Pl. Javae (1828) Addenda et emendanda, p.p. — Type species: *Grammitis macrophylla* Blume.

Dendroglossa C. Presl, Epim. Bot. (1849) 149; Copel., Gen. Fil. (1947) 199. — Type species: *Dendroglossa normalis* C. Presl.

Anapausia C. Presl, Epim. Bot. (1851) 185. — *Paraleptochilus* Copel., Gen. Fil. (1947) 198. — Type species: *Leptochilus decurrens* Blume.

Colysis C. Presl, Epim. Bot. (1851) 146, p.p.; Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 313, p.p.; Copel., Gen. Fil. (1947) 198, p.p.; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 219. — Type species: *Colysis hemionitidea*.

Gymnogramme sect. *Selliguea* Hook., Sp. Fil. 5 (1864) 161, p.p. — Type species: *Grammitis macrophylla* Blume.

Rhizome not white waxy, creeping, roots present but absent in *L. axillaris*. *Rhizome scales* pseudopeltate or peltate, clathrate or subclathrate, sometimes with a central tuft of hairs. *Fronde* monomorphic to strongly dimorphic, stipitate, simple or pinnatifid, thin-herbaceous to subcoriaceous. *Venation*: veins branching less than halfway to or near the margin, or seemingly close to the costa, connecting veins anastomosing; included veins amply anastomosing; free veinlets excurrent and recurrent, recurrent in marginal areoles. *Sori* separate, in a row between the veins, or in

wide fertile fronds forming transverse coenosori, sometimes broadened into an acrostichoid patch; in narrow fertile fronds longitudinal, narrow and linear coenosori near the margin of these fronds. — **Fig. 16.**

Distribution — Southeast Asia to Japan, throughout *Malesia* to Australia and Solomon Islands.

Taxonomy — The species here included in *Leptochilus* have at different times been assigned to several genera in the microsoroid *Polypodiaceae*, and do not form an obvious natural group. The main defining character of *Leptochilus*, the linear coenosori, has possibly been derived several times independently in different lines.

KEY TO THE SPECIES

- 1a. Lamina pinnatifid or pinnate at base **3. *L. ellipticus***
- b. Lamina simple or irregularly lobed **2**
- 2a. Lamina irregularly lobed. **6. *L. x hemitomus***
- b. Lamina simple **3**
- 3a. Sori acrostichoid, in elongated coenosori **4**
- b. Sori separate or forming transverse coenosori **6**
- 4a. Roots absent, rhizome with a line of hairs, scales peltate, connecting veins catadromous, smaller veins prominent and distinct **1. *L. axillaris***
- b. Roots densely set, scales pseudopeltate, connecting veins anadromous, smaller veins more or less immersed and indistinct **5**
- 5a. No prominent connecting basisopic vein branching off near the costa, lamina ovate, or narrowly ovate, stipe 1.2–1.7 mm thick., veins prominent and distinct **2. *L. decurrens***
- b. A prominent basisopic (or sometimes acrosopic) connecting vein dichotomously branching off near the costa, the lamina narrowly elliptic or narrowly obovate, stipe 0.5–1 mm thick, veins more or less immersed and indistinct **5. *L. minor***
- 6a. Scales 1–2 mm wide, rhizome with both sclerified circumvascular sheaths and scattered sclerenchyma strands **4a. *L. macrophyllus* var. *macrophyllus***
- b. Scales 0.3–0.8 mm wide, rhizome with either sclerified circumvascular sheaths or scattered sclerenchyma strands **7**
- 7a. Scales 1.2–2 mm long, rhizome with sclerified circumvascular sheaths only, lamina thin-herbaceous. — Borneo, Philippines **4b. *L. macrophyllus* var. *fluviatilis***
- b. Scales 3–4 mm long, rhizome with scattered sclerenchyma strands only, lamina herbaceous. — Sumatra, Peninsular Malaysia, Java **4c. *L. macrophyllus* var. *pedunculatus***

1. *Leptochilus axillaris* (Cav.) Kaulf.

Leptochilus axillaris (Cav.) Kaulf., Companion Bot. Mag. (1824) 147; Backer & Posth., Varenfl. Java (1939) 231; Blume, Enum. Pl. Javae (1828) 205; Copel., Fern Fl. Philipp. 3 (1960) 488; Holttum, Revis. Fl. Malaya 2 (1954) 164; Noot., Blumea 42 (1997) 278. — *Acrostichum axillare* Cav., Ann. Hist. Nat. 1 (1799) 101, Descr. Pl. (1801) n. 582; Sw., Syn. Fil. (1806) 11, 16. — *Gymnopteris axillaris* var. *axillaris* Bedd., Handb. Ferns Brit. India (1883) 430. — Type: *Née s.n.* (n.v.).

Leptochilus platyphyllus Copel., Philipp. J. Sc. 37 (1928) 340. — Type: *Hancock 61* (K, PE).

Rhizome dorsiventrally flattened, 1.5–3.5 mm wide, long-creeping, internodes to 10 cm long, not white waxy, roots absent, hairs in a ventral band on the rhizome; vascular strands 7–15, with sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* peltate, sparsely set, distinctly spreading, narrowly ovate or triangular, 0.5–2 by 0.1–0.2 mm, clathrate or subclathrate, margin denticulate. *FronDs* strongly dimorphic, stipitate, thin-herbaceous. Fertile fronds: lamina simple, linear, 15–30 by 0.1–0.5 cm; stipe 2–7 cm long. Sterile fronds: stipe 2–9 cm long, 0.9–1.5 mm thick, narrowly winged for a considerable part, lamina simple, narrowly ovate to elliptic, 9–36 by 1.1–6.5 cm, index 3–10, base cuneate to narrowly angustate, sometimes cordate and auriculate, margin entire, lower surface without acicular hairs. *Venation*: veins prominent and distinct, 7–10 mm apart, zigzag, branching at or near the costa, each costal areole giving rise to two veins, connecting veins 2–4, not clearly differentiated, cata- or anadromous, mostly forming several rows of elongated \pm hexagonal areoles, which become gradually smaller towards the margin, the costal areole bordered by several areoles, included veins prominent and distinct, free veinlets simple or once forked. *Sori* acrostichoid, covering the lamina. — **Fig. 16d.**

Distribution — In Continental Asia from India to northern Thailand. Throughout *Malesia*.

Habitat — Epiphyte, often on foot of trees or up to 6 m high, rarely epilithic. Generally in the mountains up to 2100 m altitude, rarely also in lowland.

2. *Leptochilus decurrens* Blume

Leptochilus decurrens Blume, Enum. Pl. Javae (1828) 206; C. Chr., Contr. U.S. Nat. Herb. 26 (1931) 325; Backer & Posth., Varenfl. Java (1939) 231; Holttum, Revis. Fl. Malaya 2 (1954) 164; W.C. Shieh et al., Fl. Taiwan 1, ed. 2 (1994) 494; Noot., Blumea 42 (1997) 279. — *Anapausia decurrens* C. Presl, Epim. Bot. (1851) 186; Copel., Fern Fl. Philipp. 3 (1960) 488. — *Acrostichum variabile* Hook., Sp. Fil. 5 (1864) 277. — *Gymnopteris variabilis* Bedd. in Hook., Fl. Brit. India (1868) t. 272. — *Campium decurrens* Copel., Philipp. J. Sc. 37 (1928) 351. — *Paraleptochilus decurrens* Copel., Gen. Fil. (1947) 198, t. 7. — Type: *Blume s.n.* (L).

Leptochilus lanceolatus Fée, Mém. Foug. 2. Hist. Acrost. (1845) 87, pl. 47, f. 1; Nakaike, Enum. Pterid. Jap. Filic. (1975) 339. — *Dendroglossa lanceolata* Fée, Gen. Filic. (1850–1852) 81, excl. syn. — *Gymnopteris féei* T. Moore, Index Filic. (1857) 29. — *Acrostichum lanceolatum* Hook., Sp. Fil. 5 (1864) 276, non L. (1753). — *Pleopeltis féei* Alderw., Malayan Ferns Suppl. 1 (1917) 405. — *Campium lanceolatum* Copel., Philipp. J. Sc. 37 (1928) 348, pl. 5, f. 2. — Syntypes: Hügel 1348, Perrotet s.n. (n.v.).

Leptochilus trifidus Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 26. — Type: A specimen cultivated in Hort. Bog. (BO).

Rhizome dorsiventrally flattened, 2.5–3 mm wide, short- to medium-creeping, internodes 1–15 mm long, not white waxy, roots densely set; vascular strands c. 6, without sclerified sheaths, sclerenchyma strands 20–100, scattered. *Rhizome scales* pseudopeltate, sometimes peltate, densely set, slightly spreading, narrowly ovate or triangular, 2–5 by 0.3–1 mm, clathrate or subclathrate, cells longitudinally rectangular towards the apex, margin entire to finely denticulate, central region glabrous or bearing multiseptate hairs. *FronDs* strongly dimorphic, stipitate, thin-herbaceous to herbaceous. Fertile fronds: stipe 14–50 cm long; lamina simple, linear, 0.1–1 cm wide.



Fig. 16. *Leptochilus decurrens* Blume. a. Habit; b. venation pattern of sterile lamina. — *L. macrophyllus* (Blume) Noot. var. *macrophyllus*. c. Habit. — *L. axillaris* (Cav.) Kaulf. d. Venation pattern of sterile lamina (a: van Slooten 485; b: redrawn after Nootboom 1997; c: de Wilde & de Wilde-Duyffjes 13671; d: redrawn after Nootboom 1997). Scale bars: a & c = 3 cm, b & d = 1 cm. Drawings by J.H. van Os.

Sterile fronds: stipe absent or to 18 cm long, 1.2–1.7 mm thick; lamina simple, ovate to narrowly ovate-obovate, 10–50 by 2.5–11 cm, index 2–5, lower surface without acicular hairs, base narrowly angustate, broadly long-decurrent, gradually narrowing to two ridges at base of stipe. *Venation*: veins prominent and distinct, 5–12 mm apart, more or less straight or zigzag, dichotomously branched below the middle to near the margin, or each costal areole giving rise to two lateral veins, thus the lateral veins seemingly branching at or near the costa; connecting veins 3–8, anadromous, form-

ing more or less equally sized areoles, included veins more or less immersed and indistinct, free veinlets simple or once forked. *Sori* acrostichoid, covering the lamina. — **Fig. 16a, b.**

Distribution — Continental Asia: India to southern China and northern Indochina, Indian Ocean: Christmas I. Throughout *Malesia*.

Habitat — Terrestrial, low climbing and epilithic, montane rain forest, hill evergreen forest, moss forest., often on rocks in stream. Altitude 150–2500 m, mostly at higher altitudes (in Java 1000–1500 m).

Note — This species is very variable especially in the leaf base which can be long-decurrent and not leaving a stipe, or a (long) stipe may be present. Small fronds generally have a venation with the veins forked near the costa; this venation may occur apically in larger fronds. *Leptochilus trifidus* Alderw. probably is a hybrid between *L. decurrens* and *L. macrophyllus*.

3. *Leptochilus ellipticus* (Thunb.) Noot.

Leptochilus ellipticus (Thunb.) Noot., Blumea 42 (1997) 283. — *Polypodium ellipticum* Thunb., Fl. Jap. (1784) 335; C. Chr., Acta Horti Gothob. 1 (1924) 104. — *Selliguea elliptica* Bedd., Ferns Brit. India (1870) Index. — *Pleopeltis elliptica* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — *Colysis elliptica* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 333; Copel., Fern Fl. Philipp. 3 (1960) 491. — Type: *Thunberg s.n.* (n.v.).

Rhizome dorsiventrally flattened, 2–6 mm wide, short- to medium-creeping, internodes 0.8–4 cm long, not white waxy, roots densely set. Vascular strands c. 5, rarely with weakly sclerified sheaths, sclerenchyma strands 15–100. **Rhizome scales** pseudopeltate, sparsely to densely set, slightly spreading, narrowly ovate or triangular, 2.5–4 by 0.5–1 mm, clathrate or subclathrate, margin denticulate, glabrous or central region bearing multiseptate hairs. **Fronds** not or slightly dimorphic, pinnately dissected, stipitate, thin-herbaceous. Stipe 5–56 cm long, 1.2–6.2 mm thick; lamina pinnatifid or pinnate, ovate, 12–60 by 12–50 cm, index 1–2, widest below the middle, base truncate or truncate-angustate, lower surface without acicular hairs. Lobes 2–12 at each side, basal lobes sometimes stalked, longest lobes at position 1–2(–4) from base, connected by a 0.1–0.6 cm wide wing, 8.5–26 by 0.8–4.5 cm, index 7–20, widest about the middle; apical lobe longer than upper lateral lobes, 8–23 by 1–2.6 cm, widest about the middle. **Venation:** veins more or less immersed and indistinct to prominent and distinct, 4–9 mm apart, zigzag, dichotomously branched near the margin, or (in fertile fronds) veins branching at or near the costa, each costal areole giving rise to a sterile and a fertile vein; connecting veins 2 or 3, anadromous, forming more or less equally sized, sometimes irregularly shaped, areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct to prominent and distinct, free veinlets simple or once forked. *Sori* forming transverse coenosori between each pair of veins.

Distribution — Continental and East Asia: India to China, Korea and Japan, northern Australia (Queensland, Cairns). In *Malesia*: Philippines (Luzon, Leyte, Mindanao, Samar).

Habitat — Terrestrial, rhizome creeping underground, sometimes at the base of trees, in evergreen hill forest, common in shady places. Altitude 450–2500 m.

4. *Leptochilus macrophyllus* (Blume) Noot.

- Leptochilus macrophyllus* (Blume) Noot., Blumea 42 (1997) 289. — *Grammitis macrophylla* Blume, Enum. Pl. Javae (1828) 119. — *Polypodium macrophyllum* Reinw. in Hornsch., Syll. Pl. Nov. 2 (1828) acc. to C. Chr., Ind. Fil., but not found there; C. Chr., Acta Horti Gothob. 1 (1924) 104; Backer & Posth., Varenfl. Java (1939) 197. — *Selliguea macrophylla* Blume, Fl. Javae. Filic. (1830) 127, t. 53. — *Colysis macrophylla* C. Presl, Epim. Bot. (1849) 147; Copel., Fern Fl. Philipp. 3 (1960) 490; Holttum, Revis. Fl. Malaya 2, ed. 2 (1966) 160. — *Pleopeltis macrophylla* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — Type: *Blume s.n.* (L), Java.
- Polypodium spathulaefolium* Blume, Enum. Pl. Javae (1828) 134; Fl. Javae. Filic. (1847) 171, t. 78A. — Type: *Blume s.n.* (L), Java.
- Polypodium spurium* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 226. — *Gymnogramma spurium* Hook. & Baker, Syn. Fil. (1868) 388. — *Pleopeltis spuria* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — *Colysis spuria* Ching, Sunyatsenia 5 (1940) 261. — Type: *Forsten 17* (L), Celebes.
- Polypodium regulare* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 225. — *Gymnogramma regulare* Hook. & Baker, Syn. Fil. (1868) 388. — *Pleopeltis regularis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Colysis regulare* Ching, Sunyatsenia 5 (1940) 261. — Type: *Korthals 20* (L), Borneo.
- Polypodium campyloneuroides* Baker, J. Linn. Soc. Bot. 22 (1886) 229. — *Pleopeltis campyloneuroides* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7. — *Colysis campyloneuroides* Parris, Sandakania 9 (1997) 81. — Type: *Hose 127* (P), Borneo, Sarawak.
- Gymnogramme campyloneuroides* Baker, J. Linn. Soc. Bot. 24 (1887) 261. — *Selliguea campyloneuroides* Bedd., Handb. Ferns Brit. India Suppl. (1892) 101. — *Polypodium hosei* C. Chr., Index Filic. (1906) 534. — *Pleopeltis hosei* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — Type: *Hose 208* (K), Sarawak.
- Gymnogramme acuminata* Baker, J. Bot. (1888) 326. — *Polypodium interruptum* C. Chr., Index Filic. (1906) 535. — *Pleopeltis interrupta* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Colysis acuminata* Holttum, Revis. Fl. Malaya (1955) 162, f. 73. — Type: *Hose 238* (K; iso BM), Borneo, Sarawak.
- Polypodium bolsteri* Copel., Philipp. J. Sc. 1, Suppl. (1906) 257, pl. 4a. — *Pleopeltis bolsteri* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Colysis bolsteri* Copel., Fern Fl. Philipp. 3 (1960) 489. — Type: *Bolster s.n.*, April 1906 (n.v.).
- Polypodium linealifolium* Rosenst., Nova Guinea 8, Bot. (1912) 728. — *Pleopeltis linealifolium* Alderw., Malayan Ferns (1917) 405. — Type: *von Römer 27* (BO), New Guinea.
- Polypodium loxogrammoides* Copel., Philipp. J. Sc., Bot. 7 (1912) 65. — *Pleopeltis loxogrammoides* Alderw., Malayan Ferns Suppl. 1 (1917) 405. — *Colysis loxogrammoides* M.G. Price, Contr. Univ. Michigan Herb. 16 (1987) 193. — Type: *Native coll. S 17* (not found), Borneo, Sarawak.
- Pleopeltis selligueoides* Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 18. — Type: *Brooks 256/s* (BO; iso L, P), Sumatra, Bengkulu, Lebong Tandai.
- Polypodium polysorum* Brause, Bot. Jahrb. Syst. 56 (1920) 203. — Type: *Ledermann 10159* (n.v.). — Syntype: *Ledermann 12865* (BM), New Guinea.
- Pleopeltis pseudoloxogramma* Alderw., Bull. Jard. Bot. Buitenzorg III, 5 (1922) 218. — *Selliguea pseudoloxogramma* Ching, Sunyatsenia 5 (1940) 260. — Type: *Kornassi 1373* (BO; iso L), Moluccas, Ceram.
- Selliguea membranacea* var. *fluminalis* Ridl., J. Mal. Branch Roy. Asiat. Soc. 4 (1926) 89. — *Colysis acuminata* var. *fluminalis* Hennisman in Steenis, Rheophytes of the World (1981) 157; M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 15 (1991) 103. — Type: *Curtis s.n.* (iso K), Langkawi.
- [*Colysis acuminata* var. *angustata* Holttum, Revis. Fl. Malaya 2, ed. 2 (1966) 163, nom. inval.]

a. var. *macrophyllus*

Rhizome dorsiventrally flattened, 1.6–8 mm thick, short-creeping, internodes 1–20 mm long, rarely longer, not white waxy, the roots densely set. Vascular strands 5–20, with sclerified sheaths, sclerenchyma strands 20–100. *Rhizome scales* pseudopeltate, sparsely to densely set, slightly spreading, narrowly ovate or triangular, 2–7 by (1–) 1.5–2 mm, clathrate or subclathrate, cells longitudinally rectangular, margin entire or denticulate (rarely), central region glabrous or bearing multiseptate hairs. *Fronde*s monomorphic to dimorphic, sessile to stipitate, thin-herbaceous to subcoriaceous. Fertile fronds: stipe absent or to 46 cm long, otherwise similar to the sterile ones. Sterile fronds: stipe absent or to 20 cm long, 0.8–5 mm thick; lamina simple, narrowly elliptic to obovate, 14–60 by 4–13 cm, index 3–15, base truncate/cuneate-angustate to narrowly angustate, narrowly decurrent, sometimes reaching base of stipe as two narrow ridges, margin entire or undulate, apex acuminate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct to prominent and distinct, 4–7.5 mm apart, more or less straight or zigzag, dichotomously branched near the margin, or (in fertile fronds) veins branching at or near the costa, each costal areole giving rise to a sterile and a fertile vein; connecting veins (2–)3–6, anadromous, forming more or less equally sized, sometimes irregularly shaped areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct or prominent and distinct; free veinlets simple or once forked. *Sori* separate, superficial or slightly immersed, (4–)5–20 per veinlet, in a single row or forming transverse coenosori between each pair of veins, on the whole surface of the lamina. — **Fig. 16c.**

Distribution — Southern China and Japan, Indochina. Throughout *Malesia*. Pacific Ocean: Solomon Islands.

Habitat — Terrestrial and on rocks by streams to low epiphyte on small trees, rarely in open land, usually in wet places. Low altitudes to 1800 m.

Uses — Dried over fire and eaten instead of salt (Papua New Guinea, Mt Hagen).

Note — *Polypodium linealifolium* Rosenst. is close to var. *fluviatilis*.

b. var. *fluviatilis* (Lauterb.) Noot.

Leptochilus macrophyllus var. *fluviatilis* (Lauterb.) Noot., Blumea 42 (1997) 289. — *Polypodium fluviatile* Lauterb., Bot. Jahrb. Syst. 44 (1910) 507. — *Pleopeltis fluviatilis* Alderw., Malayan Ferns Suppl. 1 (1917) 403. — *Colysis fluviatilis* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 319; Steenis, Rheophytes of the World (1981) 157; M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 15 (1991) 104. — Type: Winkler 2830 (BM, K, L), Borneo.

Rhizome 1.2–3 mm wide, roots sparsely to densely set; vascular strands 5–10, sclerenchyma strands absent. *Rhizome scales* ovate, narrowly ovate or triangular, 1.2–2 by 0.3–0.8 mm, margin entire or minutely denticulate, apex acute, central region glabrous. *Fronde*s strongly dimorphic, thin-herbaceous. Fertile fronds: stipe 17–40 cm, lamina simple, narrowly elliptic to linear, 12–25 by 0.3–1.3 cm. Sterile fronds: stipe 1.5–13 cm, 0.7–1.4 mm thick, lamina narrowly elliptic to ovate, 11–22 by 2–4 cm, base cuneate-angustate. *Venation*: veins 3–6 mm apart; connecting veins 3–5, always forming one row of small primary costal areoles parallel to the costa. *Sori* always in transverse coenosori, paraphyses simple uniseriate hairs with glandular top cells.

Distribution — *Malesia*: Borneo, Philippines.

Habitat — On rocks in and by streams, often submerged. Low altitudes.

Note — This variety does not differ much from some other dimorphic forms of *L. macrophyllus*. It is a rheophyte and the rhizome lacks sclerenchyma strands. Possibly *Polypodium linealifolium* Alderw., Nova Guinea 8, Bot. (1912) 728 belongs here.

c. var. *pedunculatus* (Hook. & Grev.) Noot.

Leptochilus macrophyllus var. *pedunculatus* (Hook. & Grev.) Noot., Blumea 42 (1997) 290. — [*Grammitis hamiltoniana* Wall., Cat. (1829) n. 9, nom. nud.] — *Ceterach pedunculatum* Hook. & Grev., Icon. Filic. (1829) t. 5. — *Selliguea hamiltoniana* C. Presl, Tent. Pterid. (1836) 216; Bedd., Ferns Brit. India (1867) t. 239; H. Christ, Bull. Soc. Bot. France 52, Mém. 1 (1905) 21. — *Selliguea pedunculata* C. Presl, Epim. Bot. (1851) 146. — *Gymnogramme hamiltoniana* Hook., Sp. Fil. 5 (1864) 161; Hook. & Baker, Syn. Fil. (1868) 389. — *Polypodium pedunculatum* Salomon, Nomencl. Gefässkrypt. (1883) 312. — *Pleopeltis pedunculata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — *Colysis pedunculata* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 321; Holttum, Revis. Fl. Malaya 2 (1954) 160. — Type: Wallich 9 (K), India.

Grammitis membranacea Blume, Enum. Pl. Javae (1828) 118. — *Selliguea membranacea* Blume, Fl. Javae. Filic. (1830) 123, t. 52, f. 2. — *Colysis membranacea* C. Presl, Epim. Bot. (1849) 147; Copel., Fern Fl. Philipp. 3 (1960) 490. — *Polypodium selliguae* Mett., Farngatt. I. Polypodium (1856) 111. — *Pleopeltis selliguae* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Colysis selliguae* Ching, Sunyatsenia 5 (1940) 261. — Type: Blume s.n. (L), Java.

Leptochilus ovatus Copel., Philipp. J. Sc., Bot. 9 (1914) 229. — *Campium ovatum* Copel., Philipp. J. Sc. 37 (1928) 354, pl. 6. — Type: Brooks 155 (BM, P), Sumatra.

Rhizome 2–5 mm wide, roots densely or sparsely set; sclerenchyma strands (5–) 50–150. *Rhizome scales* 3–4 by 0.5–0.8 mm, margin denticulate, apex acute. *Fronds* strongly dimorphic, herbaceous. Fertile fronds: stipe 13–45 cm long; lamina simple, deltoid, ovate, elliptic or narrowly elliptic, 4–24 by 1–5 cm. Sterile fronds: stipe absent or to 12 cm long, 1.6–2 mm thick; lamina simple, elliptic to narrowly ovate, 14–34 by 2–10 cm, base cuneate-angustate to narrowly angustate, decurrent, forming two ridges at base of stipe. *Venation*: veins prominent and distinct, dichotomously branched near the margin. *Sori* in transverse coenosori, sometimes in nearly acrostichoid patches between the veins.

Distribution — Continental Asia: Himalayas to China and Indochina. In *Malesia*: Peninsular Malaysia, Sumatra, Langkawi Is., Java.

Habitat — Epiphytic and epilithic, on boulders by stream, along coast in Peninsular Thailand. Altitude 0–1500 m.

5. *Leptochilus minor* Fée

Leptochilus minor Fée, Mém. Foug. 2. Hist. Acrost. (1845) 87, pl. 25, f. 3; Noot., Blumea 42 (1997) 292. — [*Gymnopteris normalis* J. Sm., J. Bot. (Hook.) 3 (1841) 403, nom. nud.] — *Dendroglossa normalis* C. Presl, Epim. Bot. (1851) 149, nom. illeg.; Fée, Gen. Filic. (1850–1852) 81. — *Acrostichum minus* Mett., Fil. Hort. Bot. Lips. (1856) 20; Hook., Sp. Fil. 5 (1864) 277. — *Gymnopteris minus* Hook., Sec. Cent. Ferns (1861) t. 78. — *Acrostichum lanceolatum* var. *normale* Hook., Sp. Fil. 5 (1864) 277. — *Campium minus* Copel., Philipp. J. Sc. 37 (1928) 345, pl. 4, f. 1. — *Dendroglossa minor* Copel., Gen. Fil. (1947) 199; Fern Fl. Philipp. 3 (1960) 491. — *Colysis minor* M.G. Price, Kalikasan 3 (1974) 176. — Type: Cuming 326 (K, P), Philippines, Samar.

Leptochilus linnaeanus Fée, Mém. Foug. 2. Hist. Acrost. (1845) 87, pl. 47, f. 2, excl. syn. — *Acrostichum linnaeanus* Hook., Sec. Cent. Ferns (1860) t. 26. — *Campium linnaeanum* Copel., Philipp. J. Sc. 37 (1928) 343, pl. 3. — Type: *Zollinger 1441* (n.v.).
Leptochilus rizalianus H. Christ, Bull. Herb. Boiss. II, 6 (1906) 1004. — Type: *Loher s.n.*, IV-1906 (n.v.), Philippines, Rizal.

Rhizome dorsiventrally flattened, 1.5–2.2 mm wide, short-creeping, the internodes 3–10 mm long, not white waxy, roots densely set; vascular strands 4–10, with or without sclerified sheaths; sclerenchyma strands 0–50. *Rhizome scales* pseudopeltate, sparsely set, slightly spreading, narrowly ovate or triangular, 1.2–3 by 0.2–0.75 mm, clathrate or subclathrate, margin denticulate, apex acute, cells longitudinally rectangular towards the apex, central region glabrous or bearing multiseptate hairs. *Fronds* strongly dimorphic, sessile or stipitate, herbaceous. Fertile fronds: stipe 1–32 cm, 0.5–1 mm thick; lamina simple, narrowly ovate to linear, 0.1–0.4 cm wide. Sterile fronds: stipe absent or to 3 cm long; lamina narrowly elliptic to obovate, 1.7–42 by 0.6–2.3(–2.5) cm, index 4–20, base cuneate-angustate, decurrent, forming two ridges at base of stipe, margin entire, apex rounded, rarely acute, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct, 2–10 mm apart, zigzag, dichotomously branched below or at the middle, or each costal areole giving rise to two lateral veins, thus the lateral veins seemingly branching at or near the costa, connecting veins 1–2(–3), anadromous, forming more or less equally sized areoles or one row of large areoles bordered by several smaller areoles; included venation variously anastomosing, smaller veins more or less immersed and indistinct, free veinlets simple or once forked. *Sori* acrostichoid.

Distribution — Continental Asia: India, Sri Lanka, Indochina. In *Malesia*: Sumatra, Borneo, Philippines, Sulawesi.

Habitat — Terrestrial, often on rocks in stream along water level, rarely epiphytic. Altitude 100–1200 m.

Note — Larger forms of this species merge into *L. decurrens* and may be a reduced form of the latter species. Some forms possess a metallic blue tint when alive. In dry state these plants do not differ from the rest of this taxon. The metallic tint might be induced by the rheophytic habitat.

6. *Leptochilus* × *hemitomus* (Hance) Noot.

Leptochilus × *hemitomus* (Hance) Noot., Blumea 42 (1997) 293. — *Polypodium hemitomum* Hance, J. Bot. (1883) 269. — *Colysis hemitoma* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 326; Ic. Filic. Sin. 4 (1937) pl. 197. — Type: *Henry 22104* (BM).

Rhizome dorsiventrally flattened, 1.6–8 mm thick, long-creeping, internodes 20–30 mm long, not white waxy, roots densely set. *Rhizome scales* pseudopeltate, sparsely to densely set, slightly spreading, 2–7 by 1.5–2 mm, clathrate or subclathrate, margin entire to finely denticulate, central region glabrous or bearing multiseptate hairs. *Fronds* monomorphic to dimorphic (in some forms the fertile fronds smaller than sterile ones), sessile to stipitate, thin-herbaceous. Fertile fronds: stipe 2–46 cm long, otherwise similar to the sterile ones. Sterile fronds: stipe absent or to 20 cm long, 1–5 mm thick; lamina irregularly lobed, elliptic, ovate or obovate, 14–60 by 4–13 cm, index 3–6, base truncate-angustate to narrowly angustate, very gradually and nar-

rowly decurrent to a long wing on the stipe, forming two ridges at the base of the stipe, margin entire to undulate, apex acuminate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct or prominent and distinct, 4–7 mm apart, more or less straight or zigzag, dichotomously branched near the margin, or lateral veins branching at or near the costa, each costal areole giving rise to a sterile and a fertile vein, connecting veins 3–6, anadromous, forming more or less equally sized areoles, free veinlets simple or once forked. *Sori* in transverse coenosori, superficial or slightly immersed, on the whole surface of the lamina.

Distribution — East Asia: China, Japan, Vietnam. In *Malesia*: Borneo, Sulawesi.

Note — This species is a hybrid between *L. macrophyllus* and, possibly, *L. elliptica*. It shows hybrid irregularity in blade outline. The plants have fewer sporangia and more paraphyses than the parent species. Few of the sporangia develop fully, and those that do fail to produce spores and do not dehisce in a normal manner

MICROSORUM

(M.T.M. Bosman, P.H. Hovenkamp & H.P. Nootboom)

Microsorium Link, Hort. Berol. 2 (1833) 110; Bosman, Leiden Bot. Ser. 14 (1991) 69; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 219; Noot., Blumea 42 (1997) 294.

— Type species: *Microsorium irregulare* Link (= *Microsorium punctatum*).

Phymatodes C. Presl, Tent. Pterid. (1836) 195, nom. illeg., p.p. excl. type.

[*Cheiropteris* H. Christ, Bull. Herb. Boiss. 6 (1898) 876, nom. illeg.] — *Neocheiropteris* H. Christ, Bull. Soc. Bot. France, Mém. 52 (1905) 21; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 219. — Type species: *Neocheiropteris palmatopedata* H. Christ.

Dendroconche Copel., Philipp. J. Sc., Bot. 6 (1911) 91. — Type species: *Dendroconche annabellae* H.O. Forbes (= *Microsorium linguiforme*).

Myuropteris C. Chr., Dansk Bot. Ark. 6 (1929) 73, pl. 9, f. 1, 2; pl. 10, f. 3. — Type species: *Myuropteris cordata* C. Chr.

Phymatosorus Pichi Serm., Webbia 28 (1973) 457; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 221. — Type species: *Phymatosorus scolopendria* Pichi Serm.

Tricholepidium Ching, Acta Phytotax. Geobot. 29 (1978) 41. — Type species: *Polypodium normale* Don.

Rhizome creeping, white waxy or not, roots present. *Rhizome scales* pseudopeltate or peltate, clathrate or subclathrate, sometimes with hyaline margin, often with a central tuft of multiseptate hairs. *FronDS* monomorphic to dimorphic, simple or pinnatifid, membranaceous to chartaceous. *Venation* (all types): veins branching less than half-way or near margin, or seemingly close to the costa, connecting veins ana- or catadromous; included veins amply anastomosing; free veinlets excurrent and recurrent, recurrent in marginal areoles, sometimes with a distinct marginal vein. *Sori* always separate, round or elongate on veinlets, superficial or deeply sunken, scattered over the lamina or in one to several irregular rows between costa and margin. Paraphyses generally uniseriate, but sometimes biseriate or peltate and clathrate. — **Fig. 17.**

Distribution — Paleotropical, extending to E Australia and New Zealand, eastwards to most tropical islands in the Pacific.

Taxonomy — *Microsorium* is closely related to *Leptochilus*, the only difference being in the arrangement of the sori. *Lepisorus* is very similar and here distinguished

mainly for practical reasons. It can be recognised by the constant combination of sori in a single row between costa and margin and peltate paraphyses. In *Microsorium*, the species with a similar, single row of sori lack peltate paraphyses. In this circumscription, *Microsorium* is almost certainly not a monophyletic group, and should minimally be made to include *Leptochilus* in order to be monophyletic. A more complete revision of *Lepisorus* and related ferns is necessary to assess whether *Microsorium* and *Leptochilus* together form a monophyletic group within the lepisorioid ferns or whether the opposite is more likely.

Important characters within *Microsorium* are found in the rhizome scales, the presence or absence of sclerenchyma in the rhizome, the disposition of the sori and the venation pattern. Especially this last character shows a considerable variation, but a full evaluation of its value requires still more knowledge about ontogeny and development of the patterns.

Nooteboom arranged the species in a number of groups, mainly based on soral disposition and venation pattern. More properly, his groups should be considered as morphological types, as several species are included in more than one of the groups. A satisfactory systematic subdivision of *Microsorium* is still lacking.

KEY TO THE SPECIES OF MALESIA

- 1a. Lamina pinnate, with mostly free lobes, at most the upper 1 or 2 pairs adnate 2
 - b. Lamina simple or variously divided, the lobes all adnate or connected along the rachis 3
- 2a. Lobes 7–20 on each side of the rachis, scales circular or elliptic, often with eroded margins, sori in a single row between costa and margin **14. *M. lucidum***
 - b. Lobes 4 or 5 on each side of the rachis, scales (narrowly) ovate or triangular, sori scattered over the lamina **3. *M. cinctum***
- 3a. Sori deeply sunken, visible as protrusions on the upper surface 4
 - b. Sori superficial or slightly immersed 8
- 4a. Longest lobes 0.3–0.5 cm wide, scales 0.2–0.3 mm wide, sorus close to the margin **1. *M. aurantiacum***
 - b. Longest lobes 0.7–7 cm wide, scales 0.5–3.5 mm wide, sori generally close to the costa, at most halfway to the margin 5
- 5a. Rhizome not white waxy, with scattered sclerenchyma strands or with sclerified circumvascular sheaths, scales pseudopeltate 6
 - b. Rhizome white waxy, with both scattered sclerenchyma strands and sclerified circumvascular sheaths, scales peltate 7
- 6a. Lamina margin entire, rhizome dorsiventrally flattened, with only sclerified circumvascular sheaths, lamina herbaceous, apex of lobes rounded or acute **24. *M. rubidum***
 - b. Lamina margin undulate, rhizome more or less terete, with only scattered sclerenchyma strands, lamina membranaceous, apex of lobes long-acuminate **15. *M. membranifolium***
- 7a. Scales 2–7 mm long, cells elongated, lamina herbaceous . **27. *M. scolopendria***
 - b. Scales 0.5–1.3 mm long, cells more or less isodiametric, lamina thin-herbaceous or membranaceous **18. *M. papuanum***

- 8a. Sori more or less regularly spaced, either in a single row (sometimes irregularly doubled) between costa and margin, or in two rows between the lateral veins 9
- b. Sori irregularly scattered over the lamina 18
- 9a. Lamina pinnatifid, or pinnate near base 10
- b. Lamina simple, rarely irregularly lobed 13
- 10a. Scales round or elliptic, the margin entire, often with eroded margins, roots densely set, lamina base narrowly angustate, the stipe winged for a considerable part 11
- b. Scales narrowly ovate or triangular, margin denticulate, roots sparsely set, lamina base cuneate-angustate or cuneate, stipe not winged 12
- 11a. Lamina pinnatifid throughout, the rhizome without sclerified circumvascular sheaths, lamina index 1.5–2, connecting veins 2–4, sori 1.6–3 mm diam. **4. *M. commutatum***
- b. Lamina pinnate in basal part, rhizome with sclerified circumvascular sheaths, lamina index 1.3, connecting veins 7, sori 1 mm diam. ... **2. *M. biseriatum***
- 12a. Scales peltate, appressed or slightly spreading, lamina with 2–16 pairs of lobes **28. *M. sibomense***
- b. Scales pseudopeltate or basifixed, distinctly spreading, lamina with 15–33 pairs of lobes **20. *M. powellii***
- 13a. Scales round or elliptic, often with eroded margins, peltate 14
- b. Scales (narrowly) ovate or triangular, pseudopeltate 15
- 14a. Lamina elliptic, index 2.5–5, base cuneate-angustate, scales 0.8–1.2 mm long **26. *M. sarawakense***
- b. Lamina linear, index 10–20, base narrowly angustate, decurrent into a long wing, scales 1.5–2.5 mm long **17. *M. normale***
- 15a. Sori in several rows between midrib and margin, in two (irregular) rows between each pair of veins, connecting veins catadromous or sometimes anadromous 16
- b. Sori in a single (sometimes irregularly doubled) row between costa and margin, connecting veins anadromous 17
- 16a. Roots densely set, rhizome terete, sclerenchyma strands 50–110, sori 1 (or 2) per veinlet **31. *M. zippelii***
- b. Roots sparsely set, the rhizome dorsiventrally flattened, sclerenchyma strands 0–15, sori 2–4 per veinlet **30. *M. superficiale***
- 17a. Lamina base narrowly angustate, decurrent into a long wing, roots sparsely set, scales glabrous, veins more or less immersed and vague. — Peninsular Malaysia **8. *M. fortunei***
- b. Lamina base truncate-angustate or cuneate-angustate, roots densely set, scales bearing multiseptate hairs at least when young, veins prominent and distinct. — Philippines **7. *M. ensatum***
- 18a. Connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles; costal areole, if present, bordered by included veins 19
- b. Connecting veins forming a row of more or less equally sized areoles between adjacent veins, costal areole, if present, bordered by the connecting veins 26

- 19a. Rhizome without sclerenchyma or circumvascular sheaths . **21. *M. pteropus***
 b. Rhizome with only circumvascular sheaths 20
- 20a. Lamina pinnatifid, or bipinnatifid 21
 b. Lamina simple 23
- 21a. Longest lobes of lamina 5–6 cm wide, widest at or above middle; lamina under-
 surface with acicular hairs, smaller veins prominent and distinct **6. *M. egregium***
 b. Longest lobes of lamina 0.5–2.5 cm wide, widest below middle; lamina under-
 surface without acicular hairs, smaller veins more or less immersed and indis-
 tinct 22
- 22a. Lamina widest below the middle, thin-herbaceous, apical lobe always longer
 than upper lateral lobes, veins prominent and distinct. — New Guinea **23. *M. rampans***
 b. Lamina widest above the middle, herbaceous or subcoriaceous, the apical lobe
 shorter or longer than upper lateral lobes, veins more or less immersed and in-
 distinct. — Philippines **19. *M. pentaphyllum***
- 23a. Lamina undersurface without acicular hairs 24
 b. Lamina undersurface with acicular hairs 25
- 24a. Smaller veins more or less immersed and indistinct, roots sparsely set, scales
 densely set, scales clathrate or subclathrate, lamina thin-herbaceous **23. *M. rampans***
 b. Smaller veins prominent and distinct, roots densely set, scales apically densely
 set, elsewhere more sparsely set, clathrate except for the hyaline marginal region,
 lamina herbaceous **12. *M. linguiforme***
- 25a. Veins immersed and distinct, phyllopodia obscure, lamina herbaceous, or sub-
 coriaceous, base truncate, stipe not or shortly winged **25. *M. samarense***
 b. Veins prominent and distinct, phyllopodia more or less distinct, lamina thin-her-
 baceous, base narrowly angustate, the stipe winged for a considerable part . . .
 **13. *M. longissimum***
- 26a. Rhizome white waxy underneath the scales, without sclerified circumvascular
 sheaths, sclerenchyma strands always present, scattered . **22. *M. punctatum***
 b. Rhizome not white waxy underneath the scales, with sclerified circumvascular
 sheaths, sclerenchyma strands absent or present 27
- 27a. Rhizome with scattered strands of sclerenchyma 28
 b. Rhizome with sclerenchyma strands situated dorsally of the vascular cylinder
 30
- 28a. Sori predominantly on connective veins, roots sparsely set, veins zigzag **30. *M. superficiale***
 b. Sori mostly irregularly scattered on the smallest veinlets, roots densely set, veins
 more or less straight 29
- 29a. Rhizome with 50–100 sclerenchyma strands, phyllopodia 1.5–6 cm apart, scales
 densely set, slightly to distinctly spreading; lamina herbaceous **16. *M. monstrosum***
 b. Rhizome with 8–15 sclerenchyma strands, phyllopodia 0.2–1.1 cm apart, scales
 apically densely set, elsewhere more sparsely set, appressed; lamina thin-herba-
 ceous **9. *M. heterocarpum***

- 30a. Sori predominantly on connective veins 31
- b. Sori mostly irregularly scattered on the smallest veinlets 32
- 31a. Rhizome bearing scales and hairs, roots sparsely set, scales densely set; connecting veins catadromous, lamina herbaceous or subcoriaceous **30. M. superficiale**
- b. Rhizome bearing only scales, roots densely set, scales apically densely set, elsewhere more sparsely set; connecting veins anadromous (rarely catadromous), lamina thin-herbaceous **11. M. insigne**
- 32a Scales peltate **29. M. sopuense**
- b. Scales pseudopeltate 33
- 33a. Connecting veins anadromous (rarely catadromous), lamina thin-herbaceous .. **11. M. insigne**
- b. Connecting veins catadromous, lamina herbaceous 34
- 34a Lamina 10–30 cm long; rhizome with 9–10 vascular bundles, roots sparsely set; scales densely set, distinctly spreading, denticulate; phyllopodia more or less distinct; stipe 0.5–1.5 mm thick, lamina base narrowly angustate, decurrent to a long wing, margin sinuate, veins more or less immersed and indistinct **10. M. heterolobum**
- b. Lamina 65–85 cm long; rhizome with 16–21 vascular bundles, roots densely set; scales apically densely, elsewhere more sparsely set, slightly spreading, dentate; phyllopodia obscure, stipe 3.5–7 mm thick, lamina base truncate or cuneate, margin entire, veins prominent and distinct .. **5. M. congregatifolium**

KEY TO THE SPECIES OF SUMATRA

- 1a. Sori in a single (sometimes irregularly doubled) row between costa and margin or between each pair of veins 2
- b. Sori scattered on the lamina surface 8
- 2a. Lamina simple 3
- b. Lamina pinnatifid 5
- 3a. Rhizome white waxy, scales (narrowly) ovate or triangular, sori deeply sunken, visible as protrusions on the upper surface **27. M. scolopendria**
- b. Rhizome not white waxy, scales round or elliptic, often with eroded margins, sori superficial or slightly immersed 4
- 4a. Lamina elliptic, base cuneate-angustate, scales 0.8–1.2 mm long **26. M. sarawakense**
- b. Lamina linear, base narrowly angustate, decurrent into a long wing, scales 1.5–2.5 mm long **17. M. normale**
- 5a. Rhizome white waxy, rhizome with both sclerified circumvascular sheaths and scattered sclerenchyma strands **27. M. scolopendria**
- b. Rhizome not white waxy, with scattered sclerenchyma strands or with sclerified circumvascular sheaths 6
- 6a. Sori in several rows between costa and margin, scales peltate **4. M. commutatum**
- b. Sori more or less in one row parallel to the costa, scales pseudopeltate 7

- 7a. Apex of lobes rounded or acute, lamina margin entire, rhizome dorsiventrally flattened, with sclerified circumvascular sheaths, lamina herbaceous **24. *M. rubidum***
- b. Apex of lobes long-acuminate, lamina margin undulate, rhizome terete, with scattered sclerenchyma strands, lamina membranaceous . **15. *M. membranifolium***
- 8a. Scales round or elliptic, often with eroded margins, sori predominantly on veinlets, or on distinct soral veins **4. *M. commutatum***
- b. Scales (narrowly) ovate or triangular, the margins normally intact, sori mostly irregularly scattered on the smallest veinlets or predominantly on connecting veins 9
- 9a. Connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles 10
- b. Connecting veins forming several equally sized areoles between two adjacent veins, sometimes the first connecting vein forming one row of small primary costal areoles 11
- 10a. Rhizome without sclerenchyma, sori generally absent from costal areoles **21. *M. pteropus***
- b. Rhizome with sclerified circumvascular sheaths, sori generally present in costal areoles **12. *M. linguiforme***
- 11a. Rhizome white waxy, without sclerified circumvascular sheaths **22. *M. punctatum***
- b. Rhizome not white waxy, with sclerified circumvascular sheaths 12
- 12a. Rhizome with circumvascular sclerified sheaths and strands of sclerenchyma 13
- b. Rhizome with only circumvascular sheaths 15
- 13a. Sclerenchyma strands 50–100 **31. *M. zippelii***
- b. Sclerenchyma strands 0–15 14
- 14a. Veins zigzag, roots sparsely set, scales densely set, lamina herbaceous or subcoriaceous, sori predominantly on connective veins **30. *M. superficiale***
- b. Veins more or less straight, roots densely set, scales apically densely set, elsewhere more sparsely set, lamina thin-herbaceous, sori mostly irregularly scattered on the ultimate veinlets **9. *M. heterocarpum***
- 15a. Roots sparsely set, scales densely set **30. *M. superficiale***
- b. Roots densely set, scales apically densely set, elsewhere more sparsely set . 16
- 16a. Scales in central region glabrous, margin entire or denticulate, phyllopodia more or less distinct, lamina thin-herbaceous, base narrowly angustate, decurrent to a long wing, connecting veins 1–3, between midrib and margin, mainly anadromous **11. *M. insigne***
- b. Scales in central region bearing hairs at least when young, margin dentate, phyllopodia not elevated, lamina herbaceous, base truncate or cuneate, connecting veins 4–7 between midrib and margin, catadromous . **5. *M. congregatifolium***

KEY TO THE SPECIES OF PENINSULAR MALAYSIA

- 1a. Sori scattered on the lamina 2
- b. Sori in a single row parallel to the costa or between two veins 7

- 2a. Rhizome without sclerified circumvascular sheaths, with scattered strands of sclerenchyma, white waxy underneath the scales **22. *M. punctatum***
- b. Rhizome with sclerified circumvascular sheaths, or without any sclerification, not white waxy underneath the scales 3
- 3a. Rhizome without any sclerification, venation with one row of large areoles parallel to the costa, costal areole, if present, formed by smaller veins **21. *M. pteropus***
- b. Rhizome with circumvascular sheaths; venation with several equally sized areoles, costal areole, if present, bordered by the first connecting vein 4
- 4a. Roots sparsely set, scales densely set **30. *M. superficiale***
- b. Roots densely set, scales apically densely set, elsewhere more sparsely set . 5
- 5a. Rhizome with circumvascular sheaths and scattered strands of sclerenchyma, sori on the whole surface of the lamina **9. *M. heterocarpum***
- b. Rhizome with only circumvascular sheaths, sori absent from the basal parts of the lamina 6
- 6a. Scales in central region glabrous, margin entire or denticulate, phyllopodia more or less distinct, lamina thin-herbaceous, base narrowly angustate, decurrent to a long wing, connecting veins 1–3, between midrib and margin, mainly anadromous **11. *M. insigne***
- b. Scales in central region bearing hairs at least when young, margin dentate, phyllopodia not elevated, lamina herbaceous, base truncate or cuneate, connecting veins 4–7 between midrib and margin, catadromous . **5. *M. congregatifolium***
- 7a. Lamina pinnate **14. *M. lucidum***
- b. Lamina simple or pinnatifid 8
- 8a. Sori deeply sunken, visible as protrusions on the upper surface 9
- b. Sori superficial or slightly immersed 10
- 9a. Rhizome white waxy, with sclerified circumvascular sheaths and scattered sclerenchyma strands, scales peltate, 0.6–1.4 mm wide **27. *M. scolopendria***
- b. Rhizome not white waxy, with only scattered sclerenchyma strands, scales pseudopeltate, 2.5–3.5 mm wide **15. *M. membranifolium***
- 10a. Scales circular or elliptic, peltate, often with eroded margins 11
- b. Scales (narrowly) ovate or triangular, pseudopeltate, margins usually intact 12
- 11a. Lamina elliptic, base cuneate-angustate, not long-decurrent, scales 0.8–1.2 mm long **26. *M. sarawakense***
- b. Lamina linear, base narrowly angustate, decurrent into a long wing, scales 1.5–2.5 mm long **17. *M. normale***
- 12a. Sori more or less in one row parallel to the costa, veins dichotomously branched below the middle **8. *M. fortunei***
- b. Sori in two (irregular) rows between each pair of veins, the veins dichotomously branched near the margin 13
- 13a. Roots densely set, rhizome more or less terete, sclerenchyma strands 50–110, sori 1 (or 2) per veinlet **31. *M. zippelii***
- b. Roots sparsely set, rhizome dorsiventrally flattened, sclerenchyma strands 0–15, sori 2–4 per veinlet **30. *M. superficiale***

KEY TO THE SPECIES OF JAVA AND THE LESSER SUNDA ISLANDS

- 1a. Sori deeply sunken, visible as protrusions on the upper surface 2
- b. Sori superficial or slightly immersed 4
- 2a. Rhizome white waxy, with both sclerified circumvascular sheaths and scattered sclerenchyma strands, scales peltate **27. *M. scolopendria***
- b. Rhizome not white waxy, with either scattered sclerenchyma strands or sclerified circumvascular sheaths, scales pseudopeltate 3
- 3a. Apex of lobes rounded or acute, rhizome dorsiventrally flattened, rhizome with sclerified circumvascular sheaths, lamina herbaceous, lamina margin entire
..... **24. *M. rubidum***
- b. Apex of lobes long-acuminate, rhizome terete, with only scattered sclerenchyma strands, lamina membranaceous, lamina margin undulate
..... **15. *M. membranifolium***
- 4a. Sori \pm regularly spaced, either in a single (sometimes irregularly doubled) row between costa and margin, or in two rows between the lateral veins 5
- b. Sori irregularly scattered over the lamina 8
- 5a. Lamina pinnatifid, membranaceous **4. *M. commutatum***
- b. Lamina simple, herbaceous or subcoriaceous 6
- 6a. Lamina elliptic, scales peltate, round or elliptic, often with eroded margins, sori on distinct soral veins **26. *M. sarawakense***
- b. Lamina narrowly elliptic, ovate, obovate, or linear, scales pseudopeltate, (narrowly) ovate or triangular, margin usually intact, sori predominantly on connective veins 7
- 7a. Roots densely set, rhizome terete, sclerenchyma strands 50–110, sori 1 (or 2) per veinlet **31. *M. zippellii***
- b. Roots sparsely set, rhizome dorsiventrally flattened, sclerenchyma strands 0–15, sori 2–4 per veinlet **30. *M. superficiale***
- 8a. Rhizome white waxy, with only scattered sclerenchyma strands
..... **22. *M. punctatum***
- b. Rhizome not white waxy, with sclerified circumvascular sheaths and scattered sclerenchyma strands, or not sclerified at all 9
- 9a. Roots sparsely set, scales densely set **30. *M. superficiale***
- b. Roots densely set, scales apically densely set, elsewhere more sparsely set . 10
- 10a. Rhizome with circumvascular sheaths and scattered strands of sclerenchyma, sori on the whole surface of the lamina **9. *M. heterocarpum***
- b. Rhizome with only circumvascular sheaths, sori absent from the basal parts of the lamina 11
- 11a. Scales in central region glabrous, margin entire or denticulate, phyllopodia more or less distinct, lamina thin-herbaceous, base narrowly angustate, decurrent to a long wing, connecting veins 1–3, between midrib and margin, mainly anadromous **11. *M. insigne***
- b. Scales in central region bearing hairs at least when young, margin dentate, phyllopodia not elevated, lamina herbaceous, base truncate or cuneate, not long-decurrent, connecting veins 4–7 between midrib and margin, catadromous
..... **5. *M. congregatifolium***

KEY TO THE SPECIES OF BORNEO

- 1a. Sori more or less regularly spaced, either in a single row (sometimes irregularly doubled) between the costa and the margin, or in two rows between the lateral veins 2
- b. Sori irregularly scattered over the lamina 7
- 2a. Rhizome white waxy 3
- b. Rhizome not white waxy 4
- 3a. Scales 2–7 mm long **27. *M. scolopendria***
- b. Scales 0.5–1.3 mm long **18. *M. papuanum***
- 4a. Lamina pinnatifid, membranaceous 5
- b. Lamina simple, herbaceous or subcoriaceous 6
- 5a. Sori in a single row along the costa, generally close to the costa, at most halfway to the margin, deeply sunken and visible as protrusions on the upper surface, scales pseudopeltate **15. *M. membranifolium***
- b. Sori in several rows between costa and margin, superficial or slightly immersed, scales peltate **4. *M. commutatum***
- 6a. Lamina narrowly elliptic to obovate, scales pseudopeltate, distinctly spreading, narrowly ovate or triangular, 2.5–6.5 mm long, lamina base narrowly angustate, decurrent into a long wing, sori in two (irregular) rows between each pair of veins **31. *M. zippelii***
- b. Lamina elliptic, scales peltate, appressed, round or elliptic, often with eroded margins, 0.8–1.2 mm long, lamina base cuneate-angustate, sori in a single row between each pair of veins **26. *M. sarawakense***
- 7a. Rhizome white waxy, with scattered sclerenchyma strands **22. *M. punctatum***
- b. Rhizome not white waxy, with sclerified circumvascular sheaths, or circumvascular sheaths and scattered sclerenchyma strands, or without sclerification at all 8
- 8a. Rhizome without sclerenchyma or circumvascular sclerified sheaths **21. *M. pteropus***
- b. Rhizome with circumvascular sclerified sheaths or scattered strands of sclerenchyma 9
- 9a. Venation with one row of large areoles parallel to the costa, costal areole, if present, formed by smaller veins 10
- b. Venation with several rows of areoles between costa and margin, costal areole, if present, bordered by a connecting vein 11
- 10a. Phyllopodia close together, scales densely set, clathrate or subclathrate throughout, lamina thin-herbaceous, lower undersurface with acicular hairs **13. *M. longissimum***
- b. Phyllopodia 1–7.5 cm apart, scales apically densely set, elsewhere more sparsely set, with a hyaline marginal region, lamina herbaceous, lower surface without acicular hairs **12. *M. linguiforme***
- 11a. Rhizome with circumvascular sheaths and scattered strands of sclerenchyma, sori on the whole surface of the lamina **9. *M. heterocarpum***
- b. Rhizome with only circumvascular sheaths, sori absent from the basal parts of the lamina 12

- 12a. Scales in central region glabrous, margin entire or denticulate, phyllopodia more or less distinct, lamina thin-herbaceous, base narrowly angustate, decurrent to a long wing, connecting veins 1–3 between midrib and margin, mainly anadromous **11. *M. insigne***
- b. Scales in central region bearing hairs at least when young, margin dentate, phyllopodia not elevated, lamina herbaceous, base truncate or cuneate, not long-decurrent, connecting veins 4–7 between midrib and margin, catadromous **5. *M. congregatifolium***

KEY TO THE SPECIES OF THE PHILIPPINES

- 1a. Sori more or less regularly spaced, either in a single row between costa and margin, or in two, sometimes irregular rows between the lateral veins 2
- b. Sori irregularly scattered on the lamina surface 9
- 2a. Lamina pinnatifid 3
- b. Lamina simple or irregularly lobed 6
- 3a. Rhizome white waxy, with sclerified circumvascular sheaths and scattered sclerenchyma strands **27. *M. scolopendria***
- b. Rhizome not white waxy, with either scattered sclerenchyma strands, or sclerified circumvascular sheaths 4
- 4a. Sori superficial or slightly immersed, in one to several rows between costa and margin, scales peltate **4. *M. commutatum***
- b. Sori deeply sunken, visible as protrusions on upper surface, in one row, generally close to the costa, at most halfway to the margin, scales pseudopeltate 5
- 5a. Apex of lobes rounded or acute, rhizome dorsiventrally flattened, with sclerified circumvascular sheaths, lamina herbaceous, margin entire **24. *M. rubidum***
- b. Apex of lobes long-acuminate, the rhizome terete, with scattered sclerenchyma strands, lamina membranaceous, margin undulate **15. *M. membranifolium***
- 6a. Rhizome white waxy, sori deeply sunken, visible as protrusions on the upper surface **27. *M. scolopendria***
- b. Rhizome not white waxy, sori superficial or slightly immersed 7
- 7a. Scales round or elliptic, peltate, 0.8–1.2 mm long, often with eroded margins, roots sparsely set **26. *M. sarawakense***
- b. Scales (narrowly) ovate or triangular, pseudopeltate, 1.5–6.5 mm long, margins usually intact, roots densely set 8
- 8a. Lamina base narrowly angustate, decurrent into a long wing, rhizome with sclerified circumvascular sheaths and scattered sclerenchyma strands, sori in two (irregular) rows between each pair of veins **31. *M. zippelii***
- b. Lamina base truncate-angustate or cuneate-angustate, rhizome with only scattered sclerenchyma strands or not sclerified at all, one row of sori between costa and margin, generally close to the costa, at most halfway to the margin **7. *M. ensatum***
- 9a. Rhizome without sclerenchyma strands or sclerified circumvascular sheaths **21. *M. pteropus***
- b. Rhizome with circumvascular sclerified sheaths or scattered strands of sclerenchyma 10

- 10a. Rhizome with only scattered strands of sclerenchyma, rhizome white waxy underneath the scales **22. *M. punctatum***
- b. Rhizome with circumvascular sheaths, rhizome not white waxy underneath the scales 11
- 11a. Rhizome with circumvascular sclerified sheaths and scattered strands of sclerenchyma 12
- b. Rhizome with only circumvascular sheaths 13
- 12a. Sclerenchyma strands 50–100, scales densely set, slightly to distinctly spreading, phyllopodia 1.5–6 cm apart, lamina herbaceous ... **16. *M. monstrosum***
- b. Sclerenchyma strands 8–15, scales apically densely set, elsewhere more sparsely set, appressed, phyllopodia to 1.1 cm apart, lamina thin-herbaceous **9. *M. heterocarpum***
- 13a. Venation with one row of large areoles parallel to the costa, costal areole, if present, formed by smaller veins 14
- b. Venation with several rows of more or less equally sized areoles between costa and margin, costal areole, if present, formed by included veinlets 16
- 14a. Lamina pinnatifid or bipinnatifid, lower surface without acicular hairs **19. *M. pentaphyllum***
- b. Lamina simple, lower surface with acicular hairs 15
- 15a. Lamina base truncate, not decurrent into a long wing, scales slightly spreading, phyllopodia obscure, lamina herbaceous or subcoriaceous, included veins more or less immersed and indistinct **25. *M. samarense***
- b. Lamina base narrowly angustate, decurrent into a long wing, scales appressed, or distinctly spreading, phyllopodia more or less elevated, lamina thin-herbaceous, all veins prominent and distinct **13. *M. longissimum***
- 16a. Roots sparsely set, scales densely set, lamina margin sinuate, veins more or less immersed and indistinct **10. *M. heterolobum***
- b. Roots densely set, scales apically densely set, elsewhere more sparsely set, lamina margin entire, veins prominent and distinct 17
- 17a. Scales in central region glabrous, margin entire or denticulate, phyllopodia more or less distinct, lamina thin-herbaceous, base narrowly angustate, decurrent to a long wing, connecting veins 1–3, between midrib and margin, mainly anadromous **11. *M. insigne***
- b. Scales in central region bearing hairs at least when young, margin dentate, phyllopodia not elevated, lamina herbaceous, base truncate or cuneate, connecting veins 4–7 between midrib and margin, catadromous . **5. *M. congregatifolium***

KEY TO THE SPECIES OF SULAWESI

- 1a. Sori irregularly scattered on the lamina surface 2
- b. Sori more or less regularly spaced, either in a single row between costa and margin, or in two, sometimes irregular rows between the lateral veins 5
- 2a. Rhizome white waxy, without sclerified circumvascular sheaths **22. *M. punctatum***
- b. Rhizome not white waxy, with sclerified circumvascular sheaths 3

- 3a. Connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles; costal areole, if present, formed by smaller veins, sori 1.5–3 mm diam. **12. *M. linguiforme***
- b. Connecting veins forming several more or less equally sized areoles between two adjacent veins, sometimes forming one row of small primary costal areoles, sori 1 mm diam. 4
- 4a. Lamina index 20–40, rhizome without scattered sclerenchyma strands, scales peltate, connecting veins 3 or 4 between adjacent veins **29. *M. sopusense***
- b. Lamina index 4–8, rhizome with scattered sclerenchyma strands, scales pseudopeltate, connecting veins 6–10 between adjacent veins **9. *M. heterocarpum***
- 5a. Rhizome white waxy 6
- b. Rhizome not white waxy 7
- 6a. Scales 2–7 mm long **27. *M. scolopendria***
- b. Scales 0.5–1.3 mm long **18. *M. papuanum***
- 7a. Sori in a single row between costa and margin, singly between each pair of veins, generally close to the costa, at most halfway to the margin, deeply sunken, visible as protrusions on the upper surface 8
- b. Sori in several rows between costa and margin, or in 2 rows between the veins, superficial or slightly immersed 9
- 8a. Apex of the lobes rounded or acute, rhizome dorsiventrally flattened, with sclerified circumvascular sheaths, lamina herbaceous, lamina margin entire **24. *M. rubidum***
- b. Apex of the lobes long-acuminate, rhizome terete, with scattered sclerenchyma strands, lamina membranaceous, lamina margin undulate **15. *M. membranifolium***
- 9a. Lamina simple, scales distinctly spreading, narrowly ovate or triangular, margins usually intact **31. *M. zippellii***
- b. Lamina pinnatifid, scales appressed, circular or elliptic, often with eroded margins **4. *M. commutatum***

KEY TO THE SPECIES OF THE MOLUCCAS

- 1a. Sori more or less regularly spaced, in a single row between costa and margin, or in a single, sometimes double, row between the lateral veins, on distinct soral veins or very close to the connective veins 2
- b. Sori irregularly scattered on the surface of the lamina, mostly on the smallest veinlets 5
- 2a. Rhizome not white waxy, without sclerified circumvascular sheaths 3
- b. Rhizome white waxy, with sclerified circumvascular sheaths 4
- 3a. Apical lobe 0.9–1.7 cm wide, scales peltate, sori superficial or slightly immersed **20. *M. powellii***
- b. Apical lobe 2.5–6.5 cm wide, scales pseudopeltate, sori deeply sunken, visible as protrusions on the upper surface **15. *M. membranifolium***
- 4a. Scales 2–7 mm long, lamina herbaceous **27. *M. scolopendria***
- b. Scales 0.5–1.3 mm long, lamina thin-herbaceous or membranaceous **18. *M. papuanum***

- 5a. Connecting veins forming several more or less equally sized, sometimes irregularly shaped areoles between two adjacent veins, sometimes forming small primary costal areoles, rhizome with scattered sclerenchyma strands 6
- b. Connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles; costal areole, if present, formed by smaller veins, rhizome without scattered sclerenchyma strands 7
- 6a. Rhizome white waxy, without sclerified circumvascular sheaths, sclerenchyma strands 50–100, lamina herbaceous or subcoriaceous **22. M. punctatum**
- b. Rhizome not white waxy, with sclerified circumvascular sheaths, sclerenchyma strands 8–15, lamina thin-herbaceous **9. M. heterocarpum**
- 7a. Rhizome not sclerified at all, lamina thin-herbaceous or membranaceous **21. M. pteropus**
- b. Rhizome with sclerified circumvascular sheaths, lamina herbaceous 8
- 8a. Lamina simple, roots densely set, scales 3.5–10 mm long, lamina undersurface without acicular hairs **12. M. linguiforme**
- b. Lamina pinnatifid, roots sparsely set, scales 0.5–2 mm long, lamina undersurface with acicular hairs **6. M. egregium**

KEY TO THE SPECIES OF NEW GUINEA

- 1a. Sori irregularly scattered on the lamina surface 2
- b. Sori more or less regularly spaced, in a single row between costa and margin, or in 1 or 2 rows between the lateral veins 8
- 2a. Lamina pinnate **3. M. cinctum**
- b. Lamina simple or pinnatifid 3
- 3a. Rhizome white waxy, terete, with scattered sclerenchyma strands, connecting veins forming several \pm equally sized areoles between two adjacent veins, sometimes forming one row of small primary costal areoles **22. M. punctatum**
- b. Rhizome not white waxy, dorsiventrally flattened, without scattered sclerenchyma strands, connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles; costal areole, if present, formed by smaller veins 4
- 4a. Rhizome without sclerified circumvascular sheaths, sori generally absent from costal areoles **21. M. pteropus**
- b. Rhizome with sclerified circumvascular sheaths, sori generally present in costal areoles 5
- 5a. Lamina pinnatifid 6
- b. Lamina simple 7
- 6a. Lamina 20–40 cm long, thin-herbaceous, undersurface without acicular hairs, longest lobes widest at base or below middle, 1.3–2.5 cm wide **23. M. rampans**
- b. Lamina 45–70 cm long, herbaceous, undersurface with acicular hairs, longest lobes widest about or above middle, 5–6 cm wide **6. M. egregium**
- 7a. Stipe 0.5–1.5 mm thick, roots sparsely set, lamina thin-herbaceous, smaller veins more or less immersed and vague **23. M. rampans**
- b. Stipe 3–5 mm thick, roots densely set, lamina herbaceous, smaller veins prominent and distinct **12. M. linguiforme**

- 8a. Rhizome white waxy 9
- b. Rhizome not white waxy 11
- 9a. Scales 0.2–0.3 mm wide **1. *M. aurantiacum***
- b. Scales 0.5–1.4 mm wide 10
- 10a. Scales 2–7 mm long, cells elongated, lamina herbaceous **27. *M. scolopendria***
- b. Scales 0.5–1.3 mm long, cells small, more or less isodiametric, lamina thin-herbaceous or membranaceous **18. *M. papuanum***
- 11a. Sori in a single row between costa and margin, generally close to the costa, at most halfway to the margin 12
- b. Sori in several rows between costa and margin 14
- 12a. Sori deeply sunken, visible as protrusions on the upper surface, scales pseudopeltate, the apical lamina-lobe 2.5–6.5 cm wide ... **15. *M. membranifolium***
- b. Sori superficial or slightly immersed, scales peltate, the apical lamina-lobe 0.9–1.7 cm wide 13
- 13a. Scales peltate, appressed or slightly spreading **28. *M. sibomense***
- b. Scales basifixed or pseudopeltate, distinctly spreading **20. *M. powellii***
- 14a. Lamina simple, scales distinctly spreading **31. *M. zippellii***
- b. Lamina pinnatifid to pinnate, scales appressed or slightly spreading 15
- 15a. Scales narrowly ovate or triangular, margin usually intact, denticulate, lamina base cuneate to cuneate-angustate, not decurrent into a long wing **28. *M. sibomense***
- b. Scales round or elliptic, entire, often with eroded margin, lamina base narrowly angustate, decurrent into a long wing 16
- 16a. Rhizome without sclerified circumvascular sheaths, lamina pinnatifid throughout, index 1.5–2, connecting veins 2–4, sori 1.6–3 mm diam. **4. *M. commutatum***
- b. Rhizome with sclerified circumvascular sheaths, lamina pinnate at base, index 1.3, connecting veins 7, sori 1 mm diam. **2. *M. biseriatum***

1. *Microsorium aurantiacum* Noot.

Microsorium aurantiacum Noot., Blumea 41 (1996) 17; 42 (1997) 315. — Type: *Schlechter 17532* (B; iso P), New Guinea.

Rhizome terete, 1–1.5 mm wide, long-creeping, internodes 50–120 mm long, flaky white waxy, roots sparsely set; vascular strands 10–15, with sclerified sheaths, sclerenchyma strands 5–15. *Rhizome scales* peltate, sparsely set, appressed, round, elliptic, narrowly ovate or triangular, 0.2–0.5 by 0.2–0.3 mm, margin entire or very finely denticulate, often eroded, clathrate or subclathrate, cells longitudinally rectangular, central region glabrous. *Fronds* not or slightly dimorphic, stipitate, herbaceous. Stipe 3–8 cm long, 0.8–1 mm thick; lamina pinnatifid, 7–12 by 8–20 cm, base cuneate to cuneate-angustate, lobes 2–4 at each side, connected by a 0.1–0.2 cm wide wing, longest lobes at position 1 from base, widest at base, 4–13 by 0.3–0.5 cm, index 10–20, margin entire or undulate, apex acute, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct, connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles; included

venation variously anastomosing, more or less immersed and indistinct. *Sori* separate, round, deeply sunken, 1.5 mm diam., each sorus just outside each primary costal areole, close to the margin, visible as protrusions on the upper surface; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — *Malesia*: Papua New Guinea (Morobe Prov.). Only one collection.

2. *Microsorium biseriatum* (Bosman) Noot.

Microsorium biseriatum (Bosman) Noot., *Blumea* 42 (1997) 315. — *Phymatosorus biseriatus* Bosman, *Leiden Bot. Ser.* 14 (1991) 127. — Type: *Croft 1870* (L), New Ireland.

Rhizome dorsiventrally flattened, 7–8 mm wide, long-creeping, internodes 25–50 mm long, not white waxy, roots densely set; vascular strands 21–34, with sclerified sheaths, sclerenchyma strands 50–100. *Rhizome scales* peltate or pseudopeltate, densely set, appressed, round or elliptic, 3.5–5.5 by 3–4 mm, margin entire, often eroded, apex rounded, clathrate with a hyaline marginal region, cells small, more or less isodiametric, central region glabrous. *Fronde*s stipitate, thin-herbaceous. Stipe 30–100 cm long, 7–9 mm thick; lamina pinnate at base, pinnatifid towards apex, deltoid to ovate, 80–100 by 60–70 cm, index 1.3, widest below the middle; base narrowly angustate, decurrent to a long wing; lobes 11 or 12 at each side, longest lobes at position 3 from base, 30–40 by 4–6 cm, index 6, widest about the middle, margin entire, lower surface without acicular hairs, apical lobe longer than upper lateral lobes, widest at base, apex acuminate. *Venation*: veins prominent and distinct, 7–10 mm apart, more or less straight or slightly zigzag, running to very close to the margin; connecting veins 7, catadromous, forming small primary costal areoles, and several larger, sometimes irregularly shaped, areoles; included veins prominent and distinct, forming a network of secondary areoles in the primary areoles, but not in the costal areole, free veinlets simple to once forked. *Sori* separate, round, 1 mm diam., superficial, in two regular rows between each pair of veins, predominantly situated on veinlets, one per quaternary vein, occasionally in part on connecting veins, especially the sori closest to the costa, 5–8 per sq. cm, absent from lower 2 or 3 pairs of lobes, absent from marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — *Malesia*: New Guinea, Bismarck Archipelago, New Ireland (Mt Tumbumpo). One collection only.

Habitat — In stunted forests on ridges and upper slopes, rhizome creeping underground. Altitude 1000 m.

3. *Microsorium cinctum* Bosman

Microsorium cinctum Bosman, *Leiden Bot. Ser.* 14 (1991) 76, t. 12; Noot., *Blumea* 42 (1997) 317. — Type: *Jermy 8111* (L; iso BM, K), New Guinea.

Rhizome dorsiventrally flattened, 4.5–7 mm wide, short-creeping, internodes 3–15 mm long or longer, not white waxy, roots sparsely set; vascular strands 11–15, with sclerified sheaths, sclerenchyma strands absent. Scales pseudopeltate, densely or sparsely set, appressed to distinctly spreading, ovate, narrowly ovate or triangular, 3.5–8 by 1.5–2.5 mm, margin entire, apex acute, clathrate except in a hyaline mar-

ginal region, central region glabrous. *Fronde*s not or slightly dimorphic, stipitate, herbaceous. Sterile fronds: stipe 10–25 cm long, 1–3 mm thick; lamina 35–40 by 30–35 cm, widest below or about the middle, index 1–1.5; basal part pinnate, apical part pinnatifid or pinnate, lobes 4 or 5 at each side, longest lobes at position 2 from base, widest about or below the middle, 15–25 by 3.5–6 cm, index 4–4.5, margin entire, apical lobe conform to upper lateral lobes, apex acuminate, lower surface without acicular hairs. *Venation*: veins prominent and distinct (except the smallest), 7–13 (–17) mm apart, more or less straight, dichotomously branched about the middle to near the margin, catadromous, connecting veins forming a row of large areoles bordered by several smaller areoles; included venation variously anastomosing, more or less immersed and indistinct, free veinlets simple to twice forked. *Sori* separate, round, superficial or slightly immersed, irregularly scattered on the smallest veinlets, over the whole surface of the lamina, 15–25 per sq. cm, present in marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 3-celled.

Distribution — *Malesia*: New Guinea (West Sepik, Bewani Mts and Idenburg R.); 3 collections.

Habitat — Primary forest; shady places, a low epiphyte. Altitude 300–850 m.

Note — Mature sori were absent in all collections.

4. *Microsorium commutatum* Copel.

Microsorium commutatum Copel., Gen. Fil. (1947) 196; Noot., Blumea 42 (1997) 318. — *Polypodium commutatum* Blume, Enum. Pl. Javae (1828) Addenda; Fl. Javae. Filic. (1829) 165, t. 73; Backer & Posth., Varenfl. Java (1939) 223. — *Pleopeltis commutata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — *Phymatosorus commutatus* Pichi Serm., Webbia 28 (1973) 459. — Type: *Blume s. n.* (L), Java.

Polypodium affine Blume, Enum. Pl. Javae (1828) 126. — *Colysis affine* J. Sm., Hist. Fil. (1875) 101. — Type: *Blume s. n.* (L), Java.

Polypodium sumatranum Baker, Ann. Bot. (London) 8 (1894) 131, nom. illeg., non *Polypodium sumatranum* Baker (1880). — *Polypodium sundense* C. Chr., Index Filic. (1906) 568. — *Pleopeltis sumatrana* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — Type: *Hancock 39* (K), Sumatra.

Polypodium phanerophlebium Copel., Philipp. J. Sc. 1, Suppl. (1906) 163, t. 24. — *Pleopeltis phanerophlebia* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10. — *Microsorium phanerophlebium* Copel., Gen. Fil. (1947) 196; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 154. — Type: *Copeland 1550* (BM, fragment).

Polypodium flaccidum H. Christ, Philipp. J. Sc., Bot. 2 (1907) 178. — *Pleopeltis flaccida* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — Type: *BS (Ramos) 1087* (BO, K, P), Philippines, Rizal.

Rhizome terete, 2–11 mm thick, short-creeping, internodes 0.3–3 cm long or longer, not white waxy, roots densely set; vascular strands 20–25, without sclerified sheath, sclerenchyma strands 50–100. *Rhizome scales* peltate, rarely some pseudopeltate, sparsely to densely set (older scales deciduous), appressed, round or elliptic, 2–6 by 1–3.5 mm, apex rounded, centrally dark, obscurely clathrate, with a wide, hyaline marginal region, margin entire, often eroded, cells small, more or less isodiametric, central region bearing multiseptate hairs at least when young. *Fronde*s not or slightly dimorphic, stipitate, membranaceous. Sterile fronds: stipe 4–40 cm long, 3–8.5 mm thick, winged for a considerable part; lamina pinnatifid, 27–90 (–120) by 14–50 (–60)

cm, widest below the middle, index 1.5–2; base narrowly angustate; lobes 3–19 at each side, longest lobes at position 4–8 from base, 7–30(–35) by 1.4–4(–5.5) cm, index 5–10, widest at base to about middle, connected by a 0.5–2.2 cm wide wing, apical lobe longer than upper lateral lobes, 3–12 by 1–4 cm, widest at or just above base; lower surface without acicular hairs. *Venation*: veins prominent and distinct, 4–8 mm apart, more or less straight or zigzag; connecting veins 2–4, anadromous, forming small, inconspicuous, primary costal areoles, and one to several rows of conspicuous large areoles, more or less alternating and decreasing in size towards the margin; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein, included veins prominent and distinct, forming little areoles within the main ones except the costal areole, free veinlets simple to once forked. *Sori* separate, round, 1.6–3 mm diam, superficial or distinctly impressed, one, rarely two in each main areole, in one to several rows between costa and margin; on the whole surface of the lamina or absent from the basal parts for 0–0.5 of the total length of the lamina, paraphyses simple uniseriate hairs with glandular topcells.

Distribution — *Malesia*: Sumatra, Java, Borneo, Philippines, Sulawesi, New Guinea. Pacific: New Ireland, Solomon Is., Fiji, Hawaii.

Habitat — Mainly terrestrial, sometimes a low epiphyte, often in open places, sunny or in half-shade; generally recorded from (coral) limestone, once from ultrabasic, also in grassland. Altitude 0–2000 m.

5. *Microsorium congregatifolium* (Alderw.) Holttum

Microsorium congregatifolium (Alderw.) Holttum, Revis. Fl. Malaya 2, ed. 2 (1954) 178; Bosman, Leiden Bot. Ser. 14 (1991) 79, f. 13; Noot., Blumea 42 (1997) 319. — *Microsorium congregatum* Copel., Gen. Fil. (1947) 197, nom. illeg. — *Pleopeltis congregatifolia* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 166. — *Polypodium congregatifolium* C. Chr., Index Filic. Suppl. 3 (1934) 146, nom. illeg., non Alderw. (1924). — Lectotype: *Lörzing* 5532 (BO; iso L, UC, US), Sumatra.

Polypodium mindanense H. Christ, Bull. Herb. Boiss. II, 6 (1906) 994. — *Polypodium punctatum* var. *mindanense* Alderw., Malayan Ferns (1908) 654. — *Microsorium mindanense* Copel., Gen. Fil. (1947) 196; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 153. — Type: *Copeland* 1741 (P), Philippines, Mindanao.

Rhizome dorsiventrally flattened, 4–9 mm thick, short-creeping, internodes 2–9 mm long, not white waxy, roots densely set, forming a thick mat; vascular strands 16–21, with sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* pseudopeltate, sparsely set, slightly spreading, ovate or triangular, 1–5 by 0.3–2 mm, margin dentate, apex acute, clathrate or subclathrate, central region bearing multiseptate hairs at least when young. *Fronds* not or slightly dimorphic, stipitate or sessile, herbaceous. Stipe absent or up to 2 cm long, 3.5–7 mm thick; lamina simple, narrowly elliptic or obovate to linear, 65–85 by 4–7.5 cm, index 11–16, base truncate to cuneate, gradually decurrent into two ridges at base of the stipe; margin entire, apex acute to acuminate, lower surface without acicular hairs. *Venation*: veins prominent and distinct, 9–18 mm apart, \pm straight or zigzag, dichotomously branched near the margin; connecting veins 4–7, catadromous, forming small primary costal areoles and several more or less equally sized, sometimes irregularly shaped, areoles; included veins more or less immersed and indistinct or prominent and distinct, variously anastomosing,

free veinlets simple or once forked. *Sori* separate, round, 1–1.5 mm diam., superficial or slightly immersed, mostly irregularly scattered on the smallest veinlets, occasionally partly on tertiary veins, 1 or 2 per veinlet, present or absent in marginal and costal areoles, 5–15(–20) per sq.cm, absent from the basal part for 0.5–0.7 of total length of the lamina; paraphyses 3–8-celled, uniseriate with glandular topcells.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Philippines.

Habitat — Usually a low epiphyte, sometime epilithic near streams in valleys, humid places, usually in dense shade. Altitude 30–1600 m.

6. *Microsorium egregium* (Brause) Bosman

Microsorium egregium (Brause) Bosman, Leiden Bot. Ser. 14 (1991) 80; Noot., Blumea 42 (1997) 321. — *Polypodium egregium* Brause, Bot. Jahrb. Syst. 56 (1920) 199. — Type: *Ledermann 7542* (BM, S), New Guinea.

Rhizome dorsiventrally flattened, 3–8 mm thick, short-creeping, internodes 5–10 mm long, not white waxy, roots sparsely set; vascular strands 8–14, with sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* peltate or pseudopeltate, sparsely to densely set, appressed, (narrowly) ovate or triangular, 0.5–2 by 0.5–2 mm, margin entire or dentate, apex acute, often caducous, clathrate or subclathrate, sometimes with a hyaline margin, central region glabrous. *Fronde*s not or slightly dimorphic, stipitate, herbaceous. Stipe 0.5–22 cm long, up to 4 mm thick; lamina pinnatifid, 45–70 by 25–60 cm, index 1.5–2; widest below, at, or above the middle, base truncate-angustate or narrowly angustate, decurrent on the stipe as a narrow wing, lobes 1–5 at each side, longest lobes at position 1–3 from base, 10–40 by 5–6 cm, widest about to above the middle, index 2.2–6, apex long-acuminate, margin entire; connected by a 0.1–2 cm wide wing, apical lobe longer than upper lateral lobes, widest below the middle, apex acuminate; lower surface with acicular hairs. *Venation*: veins prominent and distinct, 9–20 mm apart, \pm straight, dichotomously branched near the margin, catadromous; connecting veins forming a row of large areoles bordered by several smaller areoles; included veins prominent and distinct, variously anastomosing within the main and marginal areoles, free veinlets simple to twice forked. *Sori* separate, round, 1–1.5 mm diam., superficial or slightly immersed, mostly irregularly scattered on the smallest veinlets, present in marginal and costal areoles, 10–15 per sq.cm, on the whole surface of the lamina; paraphyses simple uniseriate hairs with glandular topcells, 3-celled (or occasionally with a 1-celled subapical acicular branch).

Distribution — *Malesia*: Moluccas (2 coll.: Bacan, Mt Sibela and Halmahera), New Guinea (one collection only).

Habitat — Epiphyte in primary forest. Altitude 20–40 m in New Guinea, 950 m in Bacan.

7. *Microsorium ensatum* (Thunb.) H. Itô

Microsorium ensatum H. Itô, J. Jap. Bot. 11 (1935) 96; Noot., Blumea 42 (1997) 322. — *Polypodium ensatum* Thunb., Trans. Linn. Soc. London 2 (1794) 341. — *Pleopeltis ensata* T. Moore, Index Filic. II (1862) 346. — *Neocheiropteris ensata* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 109. — *Neolepisorus ensatus* Ching, Bull. Fan Mem. Inst. Biol. 10 (1940) 14. — Type: *Thunberg s. n.* (n.v.).

Rhizome slightly flattened dorsiventrally, 2–4 mm thick, short-creeping, internodes 0.7–3 cm long, not white waxy, roots densely set; vascular strands 10–20, without sclerified sheaths, or with weakly sclerified brownish sheaths, sclerenchyma strands 30–50. *Rhizome scales* pseudopeltate (but scales on stipe and lamina peltate), sparsely to densely set, appressed or distinctly spreading, ovate, narrowly ovate or triangular, 1.5–3 by 1–1.5 mm, margin denticulate to dentate, apex acute, clathrate or subclathrate, cells longitudinally rectangular towards the apex, central region bearing multi-septate hairs at least when young. *Fronde*s not or slightly dimorphic, stipitate, herbaceous or subcoriaceous. Stipe 7–45 cm long, 1–4 mm thick; lamina simple, sometimes irregularly lobed, rarely pinnatifid to bipinnatifid, 13–52 by 3–12 cm, index 2.5–8, deltoid or ovate to narrowly obovate, base truncate-angustate or cuneate-angustate, margin entire or sinuate, apex acute or acuminate (often with obtuse tip), lower surface without acicular hairs. *Venation*: veins prominent and distinct, 7–17 mm apart, more or less straight, dichotomously branching mostly near the margin, connecting veins not clearly distinct, forming an irregular pattern of areoles between the veins, sometimes with a distinct row of areoles alongside the veins; included veins more or less immersed and indistinct, free veinlets simple to twice forked. *Sori* separate, sometimes confluent, round, sometimes elongated, 2.5–5 mm diam., superficial or slightly immersed, in 1 or 2 irregular rows between each pair of veins, in one to several irregular rows between costa and margin, one row close to the costa usually present, other rows to about halfway to the margin, on the whole surface of the lamina or absent from the basal parts; paraphyses clathrate and peltate.

Distribution — India to Japan, Taiwan. In *Malesia*: Philippines (Mountain Prov., one collection from Mt Data).

Habitat — No data for the Malesian specimen.

Note — The description is mainly based on extra-Malesian material. This species is probably a hybrid between a species of *Lepisorus* and a true *Microsorium* species. In several collections the number of spores is very small, and the fronds are often irregularly incised.

8. *Microsorium fortunei* (T. Moore) Ching

Microsorium fortunei Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 304; E.H. Walker, Fl. Okinawa and Ryukyu (1976) 113; Noot., Blumea 42 (1997) 324. — *Drynaria fortunei* T. Moore, Ann. Bot. (Koenig & Sims) (1855) 708. — *Lepisorus fortunei* Kuo, Taiwania 30 (1985) 68. — Type: *Fortune s.n.* (BM, L), China.

Rhizome terete, 2–5 mm thick, medium-creeping, internodes up to 4 cm long, not white waxy, roots sparsely set; sclerenchyma strands 10–100. *Rhizome scales* pseudopeltate, densely set, appressed, ovate or triangular, 2.5–5 by 1.5–2 mm, margin entire or denticulate, basally often eroded, apex acute, often caducous, clathrate, basally with hyaline margin, cells longitudinally rectangular towards apex, central region glabrous. *Fronde*s not or slightly dimorphic, stipitate, herbaceous. Stipe 0.5–22 cm long, 1.5–3.8 mm diam.; lamina simple, narrowly elliptic to linear, 24–90 by 2–6 cm, index 8–15, base narrowly angustate, decurrent into a long wing, margin undulate, apex acute or acuminate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct, 7–12 mm apart, zigzag, distinct to about halfway

between costa and margin, then disappearing in the mesh of small veins, connecting veins not distinct, with the lesser veins forming a dense mesh of small areoles, included veins more or less immersed and indistinct, often rather irregular, free veinlets simple or once forked. *Sori* separate, round, superficial or slightly immersed, 1.5–3.5 mm diam., in one (irregular) row close to the costa, one or two rows between each pair of veins, generally close to the costa, at most halfway to the margin, on the whole surface of the lamina or absent from the basal parts; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — China, Indochina. In *Malesia*: Peninsular Malaysia (Perak, G. Batu Pateh).

Habitat — No data for Malesia. Altitude outside Malesia 400–2500 m.

Note — The description is based mainly on extra-Malesian material.

9. *Microsorium heterocarpum* (Blume) Ching

Microsorium heterocarpum (Blume) Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 295; Bosman, Leiden Bot. Ser. 14 (1991) 83; Noot., Blumea 42 (1997) 327. — *Polypodium heterocarpum* Blume, Fl. Javae. Filic. (1849) 167, t. 75. — *Pleopeltis heterocarpa* T. Moore, Index Filic. (1857) 78. — Type: *Blume s.n.* (L), Java.

Polypodium zollingerianum Kunze, Bot. Zeitung (Berlin) 6 (1846) 422. — *Pleopeltis zollingeriana* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — Type: *Zollinger 1499* (Z, BO), Java.

Nephrodium pteropodum Baker, J. Bot. 26 (1888) 325. — *Aspidium pteropus* Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1902) 183. — Type: *Hose 232* (K), Borneo.

Polypodium scortechinii Baker, Ann. Bot. (London) 5 (1891) 477. — *Pleopeltis scortechinii* Bedd., Suppl. Ferns Brit. India (1892) 95. — Type: *Scortechini 216* (K), Perak.

Campylogramma lancifolia Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 7, t. 1. — Type: *Rachmat 165* (BO), Celebes.

Rhizome, terete or dorsiventrally flattened, 2–6 mm thick, short-creeping, internodes 2–11 mm long, not white waxy, roots densely set; vascular strands 9–12, with sclerified sheaths, sclerenchyma strands 8–15. *Rhizome scales* pseudopeltate, sparsely set, appressed, ovate, narrowly ovate or triangular, 1.5–4 by 0.5–2 mm, margin denticulate to dentate, apex acute, clathrate or subclathrate, central region glabrous. *Fronds* not or slightly dimorphic, stipitate, thin-herbaceous. Sterile fronds: stipe 1.5–25 cm long, 2–4 mm thick; lamina simple, narrowly ovate to obovate or linear, 20–70 by 3.5–15 cm, index 4–8, base narrowly angustate, decurrent into a long wing, margin entire or sinuate, apex acuminate, lower surface without acicular hairs. Fertile fronds: stipe 0.5–45 cm long, lamina 20–50 cm long; otherwise similar to the sterile ones. *Venation*: veins prominent and distinct, 6–10 mm apart, more or less straight, dichotomously branched near the margin, connecting veins 6–10, catadromous, forming equally sized, sometimes irregularly shaped, areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct or prominent and distinct, variously anastomosing, free veinlets simple or once forked. *Sori* separate, round or elongate along veinlets, superficial or slightly immersed, 1 by 2–5 mm, mostly irregularly scattered on the smallest veinlets, 2 per veinlet, occasionally on tertiary veins, 10–30 per sq. cm, on the whole surface of the lamina, present in marginal areoles, generally present in costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2- or 3-celled.

Distribution — Peninsular Thailand. In *Malesia*: Peninsular Malaysia, Sumatra, Java, Lesser Sunda Islands, Borneo, Philippines, Sulawesi, Moluccas (Seram).

Habitat — Epilithic, epiphytic, or terrestrial in primary rain forest, often on slopes; shady and wet places. Altitude 50–2200 m.

10. *Microsorium heterolobum* (C. Chr.) Copel.

Microsorium heterolobum (C. Chr.) Copel., Gen. Fil. (1947) 196; Bosman, Leiden Bot. Ser. 14 (1991) 84, f. 15; Noot., Blumea 42 (1997) 328; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 152. — *Polypodium anomalum* H. Christ, Bull. Herb. Boiss. 6 (1898) 201, t. 3, f. 3, nom. illeg. — *Polypodium heterolobum* C. Chr., Index Filic. (1906) 532. — *Pleopeltis anomala* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — Type: *Loher s.n.* (P; iso K), Philippines, Luzon.

Rhizome dorsiventrally flattened, 1.5–4 mm wide, short-creeping, internodes 5–35 mm long, not white waxy, roots sparsely set; vascular strands 9–10, with sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* pseudopeltate, densely set, distinctly spreading, ovate, narrowly ovate or triangular, 2–5 by 0.5–1.5 mm, margin denticulate, apex acute, clathrate or subclathrate, central region glabrous or bearing multiseptate hairs when young. *Fronde*s not or slightly dimorphic, stipitate, herbaceous. Stipe 2–15 cm long, 0.5–1.5 mm thick; lamina simple or irregularly lobed, narrowly elliptic or ovate to linear, 10–30 by 1.5–3 cm (excluding the narrowly triangular lobes), index 6.5–15, base narrowly angustate, decurrent into a long wing, lobes, if present, up to 9 by 1 cm; margin sinuate, apex acute to acuminate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct, 5–12 mm apart, zigzag, dichotomously branched near the margin; connecting veins 2–4, catadromous, forming equally sized, sometimes irregularly shaped, areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct, variously anastomosing, free veinlets simple or once forked. *Sori* separate, round or elongate along the veinlets, superficial or slightly immersed, 1–2 by 2.5–4 mm, mostly irregularly scattered on the smallest veinlets, sometimes forming 2 irregular rows between the veins, 5–20 per sq. cm, on the whole surface of the lamina or absent from the basal parts for 0.5 of total length of lamina, present or absent in marginal areoles, generally present in costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2–4-celled.

Distribution — *Malesia*: Philippines (Luzon); see Bosman l.c.: f. 15.

Habitat — Epiphyte in primary forest. Altitude 2250–2700 m.

Note — Probably a hybrid, see Bosman l.c.

11. *Microsorium insigne* (Blume) Copel.

Microsorium insigne (Blume) Copel., Univ. Calif. Publ. Bot. 16 (1929) 112; Noot., Blumea 42 (1997) 329. — *Polypodium insigne* Blume, Enum. Pl. Javae (1828) 127; Backer & Posth., Varenfl. Java (1939) 223. — *Pleopeltis insignis* Bedd., Ferns Brit. India (1866) t. 214. — *Colysis insignis* J. Sm., Hist. Fil. (1875) 101; Bosman, Leiden Bot. Ser. 14 (1991) 108. — Type: *Zippelius s.n.* (L), Java.

Polypodium diffundens Kunze, Bot. Zeitung (Berlin) 4 (1846) 422. — Type: *Zollinger 1299* (P, Z), Java.

- Drynaria decurrens* Brackenr., U.S. Expl. Exp., Filic. 16 (1854) 48. — *Pleopeltis decurrens* T. Moore, Index Filic. II (1862) 345. — *Microsorium decurrens* Copel., Fern Fl. Philipp. 3 (1960) 481. — Type: *Brackenridge 11* (US; iso K), Philippines, Luzon.
- Polypodium dilatatum* [Wall., Cat. (1829) n. 295, nom. nud.] Hook., Sp. Fil. 5 (1864) 85, nom. illeg., non K. Hoffmann (1795). — *Pleopeltis dilatata* Bedd., Ferns Brit. India (1866) t. 122. — *Colysis dilatata* J. Sm., Hist. Fil. (1874) 101. — *Polypodium euryphyllum* C. Chr., Index Filic. (1906) 525, p.p. — *Microsorium dilatatum* Sledge, Bull. Br. Mus. Nat. Hist. (Bot.) 2 (1960) 143; E.H. Walker, Fl. Okinawa and Ryukyu (1976) 113. — *Kaulinia dilatata* B. Nayar & Kaur, Comp. Beddome's Handb. Ferns Brit. India (1974) 89. — Type: *Wallich 295* (K; iso US), Nepal.
- Polypodium dolichopterum* Copel., Philipp. J. Sc. 1, Suppl. (1906) 162. — *Pleopeltis dolichoptera* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — Type: *Copeland 1717* (BM, P, S), Philippines, Mindanao, San Ramon.
- Polypodium rivulare* Copel., Philipp. J. Sc. 1, Suppl. (1906) 163, non Vahl (1807). — *Pleopeltis rivularis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — Syntypes: *Copeland 1998* (B, BM, P), Philippines, Luzon; *Copeland 2021* (B), Philippines, Batangas.
- Pleopeltis insignis* forma *aperta* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 29. — Type: *Matthew 670* (BO; iso K), Sumatra.
- Microsorium palmatum* auct. non (Blume) Fée: Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 153, f. 19.

Rhizome dorsiventrally flattened to terete, 2–11 mm wide, short-creeping, internodes 2.5–11 mm long, not white waxy, roots densely set; vascular strands 7–16, with sclerified sheaths, rarely with sclerenchyma strands. *Rhizome scales* pseudopeltate, sparsely set, appressed to distinctly spreading, ovate, narrowly ovate or triangular, (2)–2.5–7.5 by 0.5–2.5(–3) mm, margin entire to dentate (occasionally with small triangular lobes), clathrate, central region glabrous. *Fronds* not or slightly dimorphic, sessile to stipitate, simple or pinnatifid, thin-herbaceous. Simple fronds: stipe to 10 cm long, 0.5–1.5 mm thick; lamina narrowly ovate to obovate, 2.5–65 by 0.5–6.5 cm, index 4–11, base narrowly angustate, decurrent to a narrow or sometimes wide wing, along most of the length of the stipe; margin entire (rarely sinuate), apex acute to acuminate, lower surface without acicular hairs. Dissected fronds: stipe to 85 cm long, 1.4–6.2 mm thick; lamina 8–110 cm long (the tapering base not included), 3–55 cm wide, index 3–8.5; widest below to about the middle, lobes 1–12(–14) at each side, longest lobes at position 1–3 from base, connected by a wing up to 2.5 cm wide, 2–27 by 0.3–5.5 cm, index 3–8.5, widest below or about the middle. *Venation*: veins prominent and distinct, 4–13 mm apart, more or less straight or zigzag, dichotomously branched near the margin, connecting veins 1–3, not very distinct, anadromous (rarely catadromous), forming small primary costal areole or areoles all more or less equally sized, sometimes irregularly shaped; included veins more or less immersed and indistinct, variously anastomosing, free veinlets simple or once forked. *Sori* separate, round or elongate along veinlets, superficial or slightly immersed, 0.5–1.5 by 1.5–5 mm, irregularly scattered on the smallest veinlets or in two more or less distinct rows between each pair of veins, 5–20(–30) per sq. cm, absent from the basal part for 0.3–0.5 of total length of lamina, present or absent in marginal areoles, generally present in costal areoles; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — Himalayas to Indochina, Taiwan, Japan. In *Malesia*: Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands (Flores), Borneo, Philippines.

Habitat — Usually epilithic, sometimes epiphytic in primary and secondary forest; in or along streams or falls, in undergrowth of shrubs; twice reported from caves; shady, mossy, muddy, and wet places. Altitude 50–2300 m.

12. *Microsorium linguiforme* (Mett.) Copel.

- Microsorium linguiforme* (Mett.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 116; Bosman, Leiden Bot. Ser. 14 (1991) 88; Noot., Blumea 42 (1997) 332. — *Polypodium linguiforme* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 228. — *Pleopeltis linguiforme* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6. — Lectotype: *Zippelius s.n.* (L), New Guinea.
- Polypodium annabellae* H. O. Forbes, J. Bot. 26 (1888) 33. — *Pleopeltis annabellae* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5. — *Dendroconche annabellae* Copel., Philipp. J. Sc., Bot. 6 (1911) 91. — Type: *Forbes s.n.* (n.v.), New Guinea.
- Polypodium cyclobasis* Baker, Kew Bull. (1896) 42. — Syntypes: *Kennedy s.n.*, *Micholitz s.n.* (K).
- Polypodium schumannianum* Diels in K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1900) 139, t. 3C, D. — *Pleopeltis musifolia* var. *schumanniana* Rosenst., Nova Guinea 8 (1912) 729. — *Microsorium schumannianum* Copel., Gen. Fil. (1947) 196. — Type: *Hellwig 238* (n.v.).
- Pleopeltis dendroconchoides* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1910) 165. — Type: *Jacobson s.n.* (BO, L), Sumatra.
- Dendroconche kingii* Copel., Univ. Calif. Publ. Bot. 12 (1931) 407. — Type: *King 387* (SYD), New Guinea.

Rhizome dorsiventrally flattened, 1–9 mm wide, long-creeping, internodes 10–75 mm long, not white waxy, roots densely set, forming a thick mat. Vascular strands 7–15, with sclerified sheaths, sclerenchyma strands absent. **Rhizome scales** peltate or pseudopeltate, sparsely set, appressed or slightly spreading, ovate, narrowly ovate or triangular, 3.5–10 by 1–2.5 mm, margin denticulate to dentate, clathrate with a hyaline margin, central region glabrous. **Fronds** not or slightly dimorphic (occasionally dimorphic in New Guinea), stipitate, herbaceous. Stipe up to 12 cm long, 3–5 mm thick; lamina simple, nearly round to narrowly obovate, 3–70 by 2–17 cm, index 0.8–7.5, base cordate, auriculate to narrowly angustate, decurrent to a long wing, margin entire, apex rounded to acuminate, lower surface without acicular hairs. **Venation**: veins prominent and distinct, 7–30 mm apart, more or less straight, dichotomously branched below the middle to near the margin, catadromous; connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles, costal areole, if present, formed by smaller veins (venation irregular in nearly circular fronds); included venation prominent and distinct, variously anastomosing; free veinlets simple to twice forked. **Sori** separate, round or elongate along veinlets, superficial or slightly immersed, 1.5–3 by 3–5 mm, mostly irregularly scattered on the veins or the free included veinlets, 2–15 per sq. cm, on the whole surface of the lamina or absent from the basal part for 0.7 of the total length of the lamina, present or absent in marginal areoles, generally present in costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 1–3-celled.

Distribution — *Malesia*: Sumatra, Borneo, Sulawesi, Moluccas, New Guinea. Outside *Malesia*: India (Kerala); Pacific: Solomon Is., Fiji Is.

Habitat — Usually low epiphyte, sometimes higher, rarely epilithic or terrestrial in some types of primary and secondary forest. Shady, moist places. Altitude 0–1650 m.

Uses — Uncooked, salted fronds are locally eaten in New Guinea.

Note — This species is very close to *M. rampans*, and might be conspecific.

13. *Microsorium longissimum* Fée

- Microsorium longissimum* J. Sm. ex Fée, Gen. Filic. (1850–1852) 268, t. 20B, f. 2; Noot., Blumea 42 (1997) 334. — *Polypodium myriocarpum* C. Presl ex Mett., Farnagatt. I. Polypodium (1856)

- 105, nom. nov., non *Polypodium longissimum* Blume (1828). — *Pleopeltis myriocarpa* T. Moore, Index Filic. (1857) 78; Alderw., Bull. Jard. Bot. Buitenzorg II, 11 (1913) 19. — *Microsorium myriocarpum* H. Itô, J. Jap. Bot. 11 (1935) 97, nom. illeg. — Type: *Cuming* 66 (B, BM, G, K, L, LE, P, PC, US, Z), Philippines, Luzon, Laguna Prov.
- Drynaria longifolia* Brackenr., U.S. Expl. Exp., Filic. 16 (1854) 45. — Type: *Brackenridge* US Exploring Exp. 7 (US), Philippines, Luzon.
- Polypodium sablanianum* H. Christ, Philipp. J. Sc., Bot. 2 (1907) 177. — *Pleopeltis sablaniana* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6. — *Microsorium sablanianum* Copel., Gen. Fil. (1947) 196. — Type: *Elmer* 6142 (P; iso G, K, US), Philippines, Luzon.

Rhizome dorsiventrally flattened, 2.5–8 mm wide, short-creeping, internodes up to 20 mm long, not white waxy, roots sparsely to densely set; vascular strands 6–16, with sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* pseudopeltate, densely set, appressed to distinctly spreading, ovate, narrowly ovate or triangular, 1–4.5 by 0.5–1.2 mm, margin denticulate, apex acute, clathrate or subclathrate, central region glabrous. *Fronde*s not or slightly dimorphic, stipitate, thin-herbaceous. Stipe up to 7.5 cm long, 2.5–5 mm thick; lamina simple, narrowly elliptic, obovate to linear, 35–95 by 1–9 cm, index 7.5–40, base narrowly angustate, decurrent to a long wing, margin entire, apex acuminate, lower surface with acicular hairs. *Venation*: veins prominent and distinct, 5–18 mm apart, more or less straight, dichotomously branched about the middle to near the margin, catadromous; connecting veins forming one row of large areoles parallel to the costa, bordered by several smaller areoles; costal areole, if present, formed by smaller veins; included venation prominent and distinct, variously anastomosing; free veinlets simple to twice forked. *Sori* separate, round or elongate along the veinlets, superficial or slightly immersed, 0.5–1.5 by 1–3 mm, irregularly scattered on the smaller anastomosing veins and free including veins, 10–65 per sq. cm, on the whole surface of the lamina, present in marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2–4-celled (occasionally with a 1-celled subapical acicular branch), sporangium annulus 18–23-celled, indurated cells 12–16.

Distribution — *Malesia*: Borneo (Sarawak), Philippines.

Habitat — Low epiphyte, rarely epilithic in primary or secondary forest; shady places, sometimes on limestone. Altitude 30–1200 m.

Note — This species is very close to *M. samarensis*, and might be conspecific.

14. *Microsorium lucidum* Copel.

- Microsorium lucidum* Copel., Gen. Fil. (1947) 196; Noot., Blumea 42 (1997) 335. — *Polypodium lucidum* Roxb., Calc. J. Nat. Hist. 4 (1844) 486. — *Phymatodes lucida* Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 475. — *Phymatosorus lucidus* Pichi Serm., Webbia 28 (1973) 459. — Lectotype: Roxburg drawing 1922.
- Polypodium leiorrhizum* [Wall., Cat. (1829) n. 303, nom. nud.] Mett., Fil. Hort. Bot. Lips. (1856) 37, t. 25. — *Pleopeltis leiorrhiza* T. Moore, Index Filic. II (1862) 346. — Type: *Wallich* 303 (K, L, P).

Rhizome terete, 10–18 mm thick, long-creeping, internodes 3 cm long or more, white waxy or not, roots sparsely set; vascular strands without sclerified sheaths, sclerenchyma strands 30–100. *Rhizome scales* peltate or pseudopeltate, sparsely to densely set (sometimes absent in superficial rhizomes), appressed, round or elliptic,

2–10 by 2–8 mm, margin entire, often eroded, apex rounded, clathrate with a hyaline margin, cells small, more or less isodiametric, central region glabrous. *Fronde*s not or slightly dimorphic, stipitate, thin-herbaceous. Stipe 20–50 cm long, 2.6–6 mm thick; lamina pinnate, 30–60 by 20–50 cm, widest below the middle, index 1.5–2, lobes 7–20 at each side, lowest lobes free, to 10 mm stalked, longest lobes at position 1–7 from base, 13–28 by 1.5–3.7 cm, widest about or below middle, index 5–15, apex acute to caudate (nearly filiform), margin entire, lower surface without acicular hairs; apical lobe conform to upper lateral lobes or longer. *Venation*: veins more or less immersed and indistinct or prominent and distinct, 5–7 mm apart, anadromous; connecting veins forming small, inconspicuous, costal areoles bordered by conspicuous large areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein., included veins more or less immersed and indistinct or prominent and distinct, free veinlets simple or once forked. *Sori* separate, round, superficial to deeply sunken and visible as protrusions on the upper surface, 2–3 mm diam., one sorus in, or just outside, each primary costal areole, close to the costa, at most half-way to the margin, on the whole surface of the lamina or absent from the basal parts, paraphyses simple uniseriate hairs with glandular topcells.

Distribution — Himalayas to China (Yunnan, Guizhou, Guangxi, Guangdong), Indochina. In *Malesia*: Peninsular Malaya (Perak).

Habitat — Epiphyte or epilithic on dry sandstone in dense forest. Altitude 400–1700 m.

15. *Microsorium membranifolium* (R. Br.) Ching

Microsorium membranifolium (R. Br.) Ching, Bull. Fan Mem. Inst. Biol. 10 (1941) 239; Noot., Blumea 42 (1997) 339. — *Polypodium membranifolium* R. Br., Prodr. (1810) 147. — Type: *Banks s.n.* (BM), Australia.

Polypodium plukenetii C. Presl, Reliq. Haenk. 1 (1825) 21. — Type: *Haenke s.n.* (PRC: Herb. C. Presl).

Polypodium nigrescens Blume, Enum. Pl. Javae (1828) 126; Fl. Javae. Filic. (1829) 161, t. 70; Backer & Posth., Varenfl. Java (1939) 222. — *Phymatodes nigrescens* J. Sm., Ferns Brit. & For. (1866) 94; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941). — *Pleopeltis nigrescens* Bedd., Handb. Ferns Brit. India (1883) 367. — *Microsorium nigrescens* Copel., Occ. Pap. B. P. Bish. Mus. 14 (1938) 74. — *Phymatosorus nigrescens* Pichi Serm., Webbia 28 (1973) 459; Brownlie, Nova Hedwigia Beih. 55 (1977) 381. — Lectotype: *Blume s.n.* (L), Java.

Polypodium saccatum E.J. Lowe, Ferns 2 (1858) 127, t. 59. — Type unknown.

Pleopeltis temenimborensis Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 23. — Type: *Gjellerup 794* (BO), West New Guinea.

Polypodium ithycarpum Copel., Philipp. J. Sc., Bot. 12 (1917) 64. — *Microsorium ithycarpum* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 105. — Lectotype: *Topping 1578* (US), Borneo.

[*Microsorium longipes* Copel., Fern Fl. Philipp. 3 (1960) 479; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 152, nom. nud.]

Microsorium alternifolium auct.: Copel., Gen. Fil. (1947) 197, p.p.

Rhizome more or less terete, 4–20 mm thick, short- to long-creeping, the internodes 1–3 cm or more, not white waxy, roots densely set; vascular strands to about 20, without sclerified sheaths, sclerenchyma strands 100–200. *Rhizome scales* pseudopeltate, sparsely set, appressed, round, ovate, elliptic or triangular, 4–8 mm by 2.5–3.5 mm, margin entire, often eroded, apex rounded, clathrate or subclathrate (very thin), cells

small, more or less isodiametric, central region glabrous or bearing multiseptate hairs. *Fronde*s not or slightly dimorphic, stipitate, membranaceous (often translucent). Stipe 19–100 cm long, 2.8–10 mm thick; lamina pinnatifid (rarely simple), 27–175 by 36–90 cm, elliptic to ovate, index 1–3, widest about the middle, base cuneate to narrowly angustate, decurrent to a long wing, lobes 2–20 at each side, longest lobes at position 2–10 from base, connected by a wing to 1.5 cm wide, 15–50 by 2.3–7 cm, index 8–10, widest about the middle, apex long-acuminate; apical lobe longer than upper lateral lobes, 12–48 by 2.5–6.5 cm, widest about or below the middle; margin undulate, sometimes wavy, lower surface without acicular hairs. *Venation*: veins prominent and distinct, 7–13 mm apart, more or less straight; connecting veins anadromous, forming small, inconspicuous, primary costal areoles and one row of conspicuous large areoles bordered by several rows of smaller areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein; included veins prominent and distinct, marginal vein usually present, free veinlets simple to twice forked. *Sori* separate, round or slightly elongated, deeply sunken, visible as protrusions on the upper surface, 3.2–6.5 mm diam.; one sorus in, or just outside, each primary costal areole, generally close to the costa, at most halfway to the margin, on distinct soral veins; on the whole surface of the lamina or absent from the basal parts; paraphyses biseriate, non-clathrate.

Distribution — India, Sri Lanka to Indochina, China. In *Malesia*: Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands, Borneo, Philippines, Sulawesi, Moluccas, New Guinea (including New Ireland). Pacific: Solomon Islands, Fiji, Society Is., Marquesas.

Habitat — Terrestrial, epilithic or (low) epiphytic, often on limestone but also on granite, usually in wet places. Altitude 0–1700 m.

Note — In areas where *M. rubidum* occurs the marginal vein is often obscure or absent. *Microsorium ithycarpum* is a form with less prominent venation.

16. *Microsorium monstrosum* (Copel.) Copel.

Microsorium monstrosum (Copel.) Copel., Gen. Fil. (1947) 78; Bosman, Leiden Bot. Ser. 14 (1991) 93; Noot., Blumea 42 (1997) 340. — *Polypodium monstrosum* Copel., Leaflet Philipp. Bot. 1 (1906) 78. — *Pleopeltis monstrosa* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — Type: Elmer 7174 (G, L, S), Philippines, Luzon.

Polypodium monstrosum var. *integriore* Copel., Leaflet Philipp. Bot. 1 (1906) 78. — Type: Copeland 1964 (P), Philippines, Luzon.

Polypodium monstrosum var. *laucophlebium* Copel., Leaflet Philipp. Bot. 1 (1906) 78. — Type: Copeland 2069 (P, SING), Philippines, Luzon.

Polypodium suboppositum H. Christ, Bull. Herb. Boiss. II, 6 (1906) 995. — *Pleopeltis subopposita* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — *Microsorium suboppositum* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 295. — Type: Loher s.n. (P), Philippines, Luzon.

Rhizome terete, 1.5–5 mm thick, long-creeping, internodes 15–60 mm long, not white waxy, roots densely set; vascular strands 7–11, with sclerified sheaths, sclerenchyma strands 50–100. **Rhizome scales** pseudopeltate, densely set, slightly to distinctly spreading, narrowly ovate or triangular, 3–7 by 1–1.5 mm, margin entire to denticulate, apex acute, clathrate or subclathrate, central region glabrous or bearing multiseptate hairs at least when young. *Fronde*s not or slightly dimorphic, stipitate,

herbaceous. Stipe 0.5–15(–25) cm long, 1.5–3(–3.5) mm thick; lamina simple or irregularly lobed, narrowly elliptic to linear, 25–70(–90) by 3–8 cm, index (5.5–)7.5–11(–15.5), base narrowly angustate, decurrent to a long wing, margin entire, sinuate or irregularly lobed, apex acuminate, lower surface without acicular hairs. *Venation*: veins prominent and distinct, 7–11 mm apart, more or less straight, dichotomously branched near the margin; connecting veins 4 or 5, mostly catadromous, forming equally sized, sometimes irregularly shaped, areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct, variously anastomosing, free veinlets simple or once forked. *Sori* separate, round or elongate along the veinlets, superficial or slightly immersed, 1–2 by 1.5–3 mm, mostly irregularly scattered on the smallest veinlets, 1 or 2 per veinlet, 15–30 per sq. cm, on the whole surface of the lamina or absent from the basal parts for half the total length of the lamina, present or absent in marginal areoles, generally present in costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2- or 3-celled.

Distribution — *Malesia*: Philippines.

Habitat — Low epiphytic or epilithic in evergreen forest, in shade and mossy places. Altitude 600–1700 m.

17. *Microsorium normale* (D. Don) Ching

Microsorium normale (D. Don) Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 299; Noot., Blumea 42 (1997) 341. — *Polypodium normale* D. Don, Prodr. Fl. Nepal. (1825) 1. — *Pleopeltis normalis* T. Moore, Index Filic. II (1862) 347. — *Neolepisorus normalis* Ching, Bull. Fan Mem. Inst. Biol. 10 (1940) 13. — *Neocheiropteris normalis* Tagawa, J. Jap. Bot. 27 (1952) 217; Tagawa & K. Iwats. in Fl. Thailand 3 (1989) 523. — *Tricholepidium normale* Ching, Acta Phytotax. Geobot. 29 (1978) 43. — Type: *Buchanan-Hamilton s. n.* (BM).

Polypodium longifrons [Wall., Cat. (1829) n. 274, nom. nud.] Hook. & Grev., Icon. Filic. (1831) pl. 65. — Type: *Wallich 274* (K; iso BM, L), Nepal.

Pleopeltis subnormalis Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 165. — Type: *Lörzing 5964* (L), Sumatra.

Rhizome dorsiventrally flattened, 2–4.5 mm wide, long-creeping, internodes 1–4 cm long, not white waxy, roots sparsely set; vascular strands 7–16, with conspicuous sclerified sheaths, sclerenchyma strands absent or occasionally few. *Rhizome scales* peltate, sparsely set, appressed, round or elliptic, 1.5–2.5 by 0.8–1.2 mm, margin entire, often eroded, apex rounded, clathrate with a wide, thin, hyaline margin, cells small, more or less isodiametric, central region bearing long, conspicuous multi-septate hairs at least when young. *Fronde*s not or slightly dimorphic, stipitate, thin-herbaceous or membranaceous. Stipe 1.5–7 cm long, 1–1.5 mm thick; lamina simple, linear, 25–60 by 1.8–5 cm, index 10–20, base narrowly angustate, decurrent to a long wing, margin often undulate, apex acute or acuminate (but tip sometimes blunt), lower surface without acicular hairs. *Venation*: veins prominent and distinct, (5–)7–16 mm apart, branching at or near the costa or arising in pairs, zigzag, mostly distinct to near the margin, connecting veins 2–4, often not clearly distinct, forming more or less equally sized areoles, the costal areole bordered by several areoles, or forming small, inconspicuous, primary costal areoles bordered by one row of conspicuous large areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein; included veins prominent and distinct, forming rather irregular

secondary areoles, free veinlets simple or once forked. *Sori* separate, round, 1.5–4 mm diam., superficial or slightly immersed, in one or two (irregularly alternating) rows parallel to the costa just outside the costal areole, one per veinlet, one close to the costa between the successive pairs of veins, one slightly farther from the costa between the two branches of each pair, on the whole surface of the lamina or absent from the basal parts, absent from marginal areoles and costal areoles; paraphyses clathrate and peltate.

Distribution — Northern India to China, Indochina. In *Malesia*: Sumatra, Peninsular Malaysia (Pahang).

Habitat — Terrestrial and low epiphyte. Altitude 400–2600 m.

18. *Microsorium papuanum* (Baker) Parris

- Microsorium papuanum* (Baker) Parris, Kew Bull. 41 (1986) 70; Noot., Blumea 42 (1997) 346. — *Polypodium papuanum* Baker in Becc., Malesia 3 (1886) 48. — *Pleopeltis papuana* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5. — Type: *Beccari s.n.* (K), New Guinea.
- Polypodium subgeminatum* H. Christ in K. Schum. & Lauterb., Fl. Schutzgeb. Südsee Nachtr. (1905) 47. — *Pleopeltis subgeminata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5. — *Microsorium subgeminatum* Copel., Gen. Fil. (1947) 197. — Type: *Schlechter 14482* (K), New Guinea.
- Polypodium soromanes* H. Christ, Nova Guinea 8 (1909) 152. — Type: *Versteeg 1091* (BO, L), New Guinea.
- Polypodium versteegii* H. Christ, Nova Guinea 8 (1909) 154. — Type: *Versteeg 1555* (K, L), New Guinea.
- Polypodium cromwellii* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 10 (1912) 340. — *Microsorium cromwellii* Copel., Gen. Fil. (1947) 197. — Type: *Bamler s.n.* (P), New Guinea.
- Polypodium acutifolium* Brause, Bot. Jahrb. Syst. 49 (1912) 49. — *Microsorium acutifolium* Copel., Gen. Fil. (1947) 197. — Type: *Schlechter 17064* (BM, K, L), New Guinea.
- Pleopeltis murkeleana* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 166. — *Polypodium murkeleanum* C. Chr., Index Filic. Suppl. 3 (1934) 154. — Type: *Kornassi 1473* (BO), Ceram.
- Microsorium sulawesiense* H. Ohba, J. Jap. Bot. 49 (1974) 173. — Type: *Sohma c.s. 482* (n.v.).

Rhizome terete, 1–3.9 mm thick, internodes (0.5–)2.5–9 cm, white waxy (the only collection from Borneo not so), often with short shoots bearing several phylloids close together, roots sparsely set; vascular strands 10–20, with sclerified sheaths, sclerenchyma strands 10–80. *Rhizome scales* peltate, sparsely set, appressed, round, ovate, elliptic or triangular, 0.5–1.3 by 0.5 mm, margin denticulate at least at base, often eroded, apex rounded or acute, clathrate or subclathrate, cells small, more or less isodiametric (in ovate scales longer towards the apex), central region glabrous. *Fronds* not or slightly dimorphic, simple to pinnatifid, stipitate, thin-herbaceous to membranaceous. Simple fronds: stipe 0.5–14 cm long, 0.5–1.2 mm thick; lamina narrowly elliptic to ovate, 10–27 by 0.9–4 cm, index 4–8, base cuneate, margin entire, apex acute to acuminate, lower surface without acicular hairs. Pinnatifid fronds: stipe 5–40 cm long, 1–1.8 mm thick; lamina 11–33 by 8–22 cm, widest below to above the middle, index 1–1.5; lobes 1–3 at each side, ascending, longest lobes connected by a 0.6–1.1 cm wide wing, widest about middle, 11–26 by 1.2–1.8 cm, index 8–16; upper lobes at an angle of 40–70° to the apical lobe; apical lobe longer than upper lateral lobes, 9–25 by 1.2–2.7 cm. *Venation*: veins more or less immersed and indistinct or prominent and distinct, 6–13 mm apart, catadromous (if a minor veinlet forms an in-

conspicuous costal areole this may be anadromous); connecting veins forming small, inconspicuous, primary costal areoles bordered by conspicuous large areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein; included veins \pm immersed and indistinct or prominent and distinct, forming a rather dense reticulation of secondary areoles, free veinlets simple or once forked. *Sori* separate, round, deeply sunken, visible as protrusions on upper surface, 3.5–5 mm diam.; one sorus in, or just outside, each primary costal areole, rarely also in other areoles, generally close to the costa, at most halfway to the margin, on the whole surface of the lamina; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — In *Malesia*: Borneo, Sulawesi, Moluccas, New Guinea. Pacific: Admiralty Is., Manus I., Solomon Is., New Hebrides (Aneityum), Fiji, Caroline Is.

Habitat — Terrestrial, sometimes on limestone cliffs, or epiphyte. Altitude 100–2700 m

Notes — 1. This species is closely related to, and often confused with *M. scolopendria*. The dried fronds are mostly dark brown or blackish, whereas in *M. scolopendria* they are usually yellowish green. In *M. papuanum* the sori are in one row parallel to the costa, but sometimes in two rows, in *M. scolopendria* in one to several. There are several collections intermediate between the two species, but they grow together and generally behave as good species.

2. *Polypodium soromanes* H. Christ is probably a hybrid between this species and another, unknown, species. It has simple, narrow, more or less strap-shaped fronds, often with some irregular lobes at the base, and large, sometimes elongated sori close to the midrib.

19. *Microsorium pentaphyllum* (Baker) Copel.

Microsorium pentaphyllum (Baker) Copel., Gen. Fil. (1947) 196; Bosman, Leiden Bot. Ser. 14 (1991) 95; Noot., Blumea 42 (1997) 348. — *Polypodium pentaphyllum* Baker, Ann. Bot. (London) 5 (1891) 478. — *Pleopeltis pentaphylla* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — Type: *Wallis s.n.* (MICH; iso K), Philippines.

Polypodium curranii Copel., Philipp. J. Sc., Bot. 4 (1909) 114. — *Pleopeltis curranii* Alderw., Malayan Ferns Suppl. (1917) 398. — *Microsorium curranii* Copel., Gen. Fil. (1947) 196; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 151. — Type: *Curran FB 15728* (G, M, P, PC, U, UC, US, Z), Philippines, Luzon.

Rhizome dorsiventrally slightly flattened, 2–4 mm wide, short-creeping, internodes up to 15 mm long, not white waxy, roots sparsely set; vascular strands 7 or 8, with conspicuous sclerified sheaths, sclerenchyma strands absent. **Rhizome scales** pseudopeltate, sparsely to densely set, appressed, narrowly ovate or triangular, (1–)2–5 by 0.5–1 mm, margin denticulate, clathrate or subclathrate, central region glabrous. **Fronds** not or slightly dimorphic, stipitate, herbaceous to subcoriaceous. Stipe 1.5–8 cm long, up to 2 mm thick; lamina pinnatifid (towards the apex sometimes dichotomously branched), obovate to narrowly obovate, 20–50 by 5–30 cm, index 1.5–4, widest above the middle, base narrowly angustate, decurrent to a long wing, lobes 2–4 at each side, longest lobes at position 1 or 2 from base, widest at base, 5.5–25 by 0.5–1.5 cm, index 6–20(–60), connected by a wing 0.2–1 cm wide; margin entire, apex acuminate, lower surface without acicular hairs. **Venation**: veins more or less immersed and indistinct, 4–13 mm apart, more or less straight, dichotomously branch-

ed below the middle to near the margin; one connecting vein forming a row of large areoles bordered by several smaller areoles, the costal areole, if present, formed by smaller veins; included venation variously anastomosing, more or less immersed and indistinct, free veinlets simple to twice forked. *Sori* separate, round or elongate along the veinlets, superficial or slightly immersed, 0.5–1 by 1.5 mm, mostly irregularly scattered on the smallest veinlets, 20–45 per sq.cm, on the whole surface of the lamina, present in marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2- or 3-celled.

Distribution — *Malesia*: Philippines (Luzon).

Habitat — Epiphyte in evergreen forest. Altitude 1000–2000 m.

20. *Microsorium powellii* (Hook. & Baker) Copel.

Microsorium powellii (Hook. & Baker) Copel., Gen. Fil. (1947) 196; Noot., Blumea 42 (1997) 349. — *Polypodium powellii* Hook. & Baker, Syn. Fil. (1868) 364. — *Phymatosorus powellii* Pichi Serm., Webbia 28 (1973) 459; Sykes & Game, New Zeal. J. Bot. 34 (1996) 145. — Type: *Powell 135* (K), Samoa.

Rhizome terete, 2–5.5 mm thick, internodes 1.2–4.5 cm long or longer, not white waxy, roots sparsely set; vascular strands 15–25, without sclerified sheaths, sclerenchyma strands 15–50 or more. *Rhizome scales* basifixed or pseudopeltate, sparsely to densely set, distinctly spreading, narrowly ovate or triangular, 3–13 by 2–4 mm, margin denticulate, sometimes only very slightly so, apex acute, clathrate or subclathrate, cells longitudinally rectangular, central region glabrous. *Fronds* not or slightly dimorphic, stipitate, membranaceous to thin-herbaceous. *Stipe* 23–45 cm long, 2.5–6 mm thick; lamina pinnatifid, broadly ovate to ovate, 28–100 by 25–45 cm, index 1–3, widest below to about the middle, base cuneate to cuneate-angustate, lobes 15–33 at each side, longest lobes at position 1–4 from base, connected by a wing 1–10 mm wide, widest below to about middle, 20–23 by 1–2.2 cm, index 8–12, apex acute to long-acuminate; apical lobe longer than upper lateral lobes, 6–15 by 0.9–1.7 cm, widest about middle; margin entire to undulate, lower surface without acicular hairs. *Venation*: veins slightly prominent and distinct, 4–8 mm apart, catadromous; connecting veins forming one row of small, inconspicuous, primary costal areoles, bordered by conspicuous large areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein; included veins more or less immersed and indistinct or prominent and distinct, marginal vein absent, free veinlets simple to twice forked. *Sori* separate, round, superficial or slightly immersed, 1–3 mm diam., in one row between midrib and margin, generally close to the costa, at most halfway to the margin, on the whole surface of the lamina or absent from the basal parts; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — *Malesia*: Moluccas (Seram), New Guinea. In the Pacific: Vanuatu, Solomon Is., Samoa.

Habitat — Terrestrial or epiphytic. Altitude 600–2000 m.

Note — This species is sometimes very similar to *M. rubidum*, but differs in the rhizome anatomy with many sclerenchyma strands. It also resembles *M. sibomense*, from which it differs in the rhizome scales and the generally larger fronds with more pinnae.

21. *Microsorium pteropus* (Blume) Copel.

- Microsorium pteropus* (Blume) Copel., Univ. Calif. Publ. Bot. 16 (1929) 112; Steenis, Rheophytes of the World (1981) 161; M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 15 (1991) 104; Noot., Blumea 42 (1997) 350. — *Polypodium pteropus* Blume, Enum. Pl. Javae (1828) 125, add. 3; Backer & Posth., Varenfl. Java (1939) 224. — *Pleopeltis pteropus* T. Moore, Index Filic. (1857) 78. — *Kaulinia pteropus* B. Nayar, Taxon 13 (1964) 67. — *Colysis pteropus* Bosman, Leiden Bot. Ser. 14 (1991) 112. — Lectotype: *Blume s.n.* (L), Java.
- Polypodium tridactylum* [Wall., Cat. (1829) n. 315, nom. nud.] Hook. & Grev., Icon. Filic. (1831) t. 209. — *Phymatodes tridactyle* C. Presl, Tent. Pterid. (1836) 196. — *Drynaria tridactyla* Fée, Gen. Filic. (1850-1852) 271. — *Pleopeltis tridactyla* T. Moore, Index Filic. (1857) 78. — *Colysis tridactyla* J. Sm., Hist. Fil. (1875) 101. — Type: *Wallich 315* (K; iso BM, C, K, UC, US).
- Polypodium raapii* Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 23. — *Pleopeltis raapii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5. — Type: *Raap 671* (BO), Sumatra.
- Polypodium paucijugum* Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 24. — *Pleopeltis paucijuga* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — *Microsorium paucijugum* K. Iwats. & M. Kato, Acta Phytotax. Geobot. 32 (1981) 132; M. Kato et al., J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 15 (1991) 104. — Type: *Teuscher s.n.* (BO), Borneo.
- Polypodium aquaticum* H. Christ, Nova Guinea 8 (1909) 153. — Type: *Versteeg 1203* (K, L), New Guinea.
- Microsorium brassii* Copel., J. Arnold Arbor. 10 (1929) 181. — Type: *Brass 1153* (A).
- [*Drynaria dubia* J. Sm., J. Bot. 3 (1841) 397, nom. nud.: *Cuming 324*.]

Rhizome dorsiventrally flattened, 0.5–5 mm wide, short-creeping, internodes 1.5–20 mm long, not white waxy, roots densely set; vascular strands 10–14, without sclerified sheaths, sclerenchyma strands absent or rarely 1–3. *Rhizome scales* pseudopeltate, more or less densely set, slightly spreading, narrowly ovate or triangular, 1.5–5 by 0.4–1 mm, margin entire, apex acute, clathrate or subclathrate with an opaque central region, cells longitudinally rectangular, central region glabrous or bearing multiseptate hairs when young. *Fronds* not or slightly dimorphic, simple or pinnatifid, sessile to stipitate, thin-herbaceous to membranaceous. Simple fronds: stipe absent or to 12 cm long, 1–2 mm thick, lamina narrowly elliptic, 3.5–30 by 0.2–5.5 cm, index 5–35, base narrowly angustate, decurrent to a long wing, margin entire, apex acute to acuminate, lower surface without acicular hairs, often densely covered with clavate hairs, costae and occasionally veins often densely covered with small scales. Dissected fronds: stipe 1–28 cm long; lamina 15–45 by 5–25 cm, index 3.5–8, widest about or above the middle, lobes 1, rarely 2, at each side, widest about or below middle, basal lobes rarely with a small basiscopic lobe, 4.5–17 by 0.3–5 cm; apical lobe longer than upper lateral lobes, widest at base to below middle, otherwise similar to the simple ones. *Venation*: veins prominent and distinct, 3–7 mm apart, more or less straight or zigzag, dichotomously branched about the middle to near the margin; a single connecting vein forming one large areole nearly extending to the margin, there bordered by smaller areoles; costal areole, if present, formed by smaller veins, included venation more or less immersed and indistinct or prominent, variously anastomosing, often forming several equally sized areoles within the large areole, free veinlets to twice forked. *Sori* separate, round or sometimes elongate along the veins, superficial or slightly immersed, 1–2.5 by 2–7 mm, mostly irregularly scattered on the smallest veinlets, 0–20 per sq.cm, on the whole surface of the lamina, absent from marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2- or 3-celled.

Distribution — Himalayas to Indochina, China, Japan, Taiwan. In *Malesia*: Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands, Borneo, Philippines, Moluccas (Halmahera), New Guinea.

Habitat — Along or in streams, often submerged. Altitude usually low, but sometimes up to 1200 m.

Note — A species with narrow, rheophytic, and wider land forms sometimes growing close together. Most easily recognisable by the row of large areoles, but the narrow rheophytic fronds can be recognised best by the rather dense cover of scales on the costa. A row of smaller areoles is often distinguishable within the main areole. Sometimes the sori are situated more or less in one row between the veins. Occasionally, especially in submerged plants, the apex of the lamina is proliferous.

22. *Microsorium punctatum* (L.) Copel.

- Microsorium punctatum* (L.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 111; Bosman, Leiden Bot. Ser. 14 (1991) 97, f. 20; Noot., Blumea 42 (1997) 353. — *Acrostichum punctatum* L., Sp. Pl. ed. 2 (1763) 1524. — *Polypodium punctatum* Sw., J. Bot. (Schrader) 1800 (1801) 21, non Thunb. (1784). — *Polypodium lingulatum* Sw., Syn. Fil. (1806) 30. — *Phymatodes lingulata* C. Presl, Tent. Pterid. (1836) 198. — *Pleopeltis punctata* Bedd., Suppl. Ferns S. India (1876) 22. — Type: *Fothergill s.n.* (n.v.), China.
- Polypodium polycarpon* Cav., Descr. Pl. (1801) 246; Bosman, Leiden Bot. Ser. 14 (1991) 99. — *Niphobolus polycarpus* Spr., Syst. Veg. 4 (1827) 45. — *Phymatodes polycarpa* C. Presl, Tent. Pterid. (1836) 198, t. 8, f. 19. — *Pleopeltis polycarpa* T. Moore, Index Filic. (1857) 78. — *Microsorium polycarpon* Tardieu, Fl. Madag. Fam. 5 (1960) 114. — Type: *Née s.n.* (n.v.).
- Polypodium polycarpon* Sw., J. Bot. (Schrader) 1800 (1801) 21, nom. illeg. (non Cavanilles). — *Drynaria polycarpa* Brackenr., U.S. Expl. Exp., Filic. 16 (1854) 44. — Type: *Thunberg s.n.* (UPS).
- Polypodium irioides* Poir., Encycl. 5 (1804) 513. — *Phymatodes irioides* C. Presl, Tent. Pterid. (1836) 196. — *Drynaria irioides* J. Sm., J. Bot. (Hook.) 3 (1841) 398. — *Microsorium irioides* Fée, Gen. Filic. (1850-1852) 268, t. 20B. — *Pleopeltis irioides* T. Moore, Index Filic. (1857) 78. — *Colysis irioides* J. Sm., Hist. Fil. (1875) 101. — Type: *Commerson s.n.* (P), Mauritius.
- Polypodium musifolium* Blume, Enum. Pl. Javae (1828) 134. — *Pleopeltis musifolium* T. Moore, Index Filic. (1857) 78. — *Drynaria musifolia* J. Sm., Cat. Cult. Ferns (1857) 14. — *Microsorium musifolium* Copel., Univ. Calif. Publ. Bot. 16 (1929) 112; Bosman, Leiden Bot. Ser. 14 (1991) 94. — Type: *Blume s.n.* (L), Java.
- Polypodium ambiguum* Blume, Enum. Pl. Javae (1828) 125. — Type: *Reinwardt s.n.* (L).
- Microsorium irregulare* Link, Hort. Berol. 2 (1833) 110. — Type: *Anonymus*, cult in Hortus Berlin.
- Polypodium millisori* Baker, J. Linn. Soc. Bot. 15 (1877) 109. — *Pleopeltis millisora* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — Type: *Moseley s.n.* (BM, K), Little Kei Is.
- Polypodium validum* Copel. in Perkins, Fragm. Fl. Philipp. 3 (1905) 191. — *Pleopeltis valida* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 8. — *Microsorium validum* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 295. — Type: *Copeland 973* (n.v.), Philippines, Mindanao.
- Polypodium punctatum* subsp. *subirideum* H. Christ, Bull. Herb. Boiss. II, 6 (1906) 994. — *Polypodium punctatum* var. *subirideum* Alderw., Malayan Ferns (1908) 654. — *Microsorium subirideum* Copel., Gen. Fil. (1947) 197. — Type: *Elmer 5884* (P), Philippines, Luzon.
- Polypodium punctatum* subsp. *subdrynariaceum* H. Christ, Bull. Herb. Boiss. II, 6 (1906) 994. — *Polypodium punctatum* var. *subdrynariaceum* Alderw., Malayan Ferns (1908) 654. — Type: *Ridley 8935* (P).
- Polypodium anthropyoides* Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 22. — *Pleopeltis anthropyoides* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — Type: *Forbes 3119* (BM), Sumatra.



Fig. 17. *Microsorium sopuense* Bosman. a. Habit. — *M. superficiale* (Bedd.) Ching. b. Venation pattern. — *M. rubidum* (J. Sm.) Copel. c. Venation pattern. — *M. punctatum* (L.) Copel. d. Venation pattern (a: from Bosman 1991; b–d: after Nootboom 1997). — Scale bars = 1 cm.

Polypodium neoguineense Copel., Philipp. J. Sc., Bot. 6 (1911) 89. — *Pleopeltis neoguineensis* Alderw., Malayan Ferns Suppl. 1 (1917) 390. — *Microsorium neoguineense* Copel., Gen. Fil. (1947) 196. — Type: *King 335* (SYD, n.v.), New Guinea.

Pleopeltis megalosoroides Alderw., Nova Guinea 14 (1924) 39. — Type: *Lam 1365* (L; iso BO), New Guinea.

Microsorium glossophyllum Copel., Gen. Fil. (1947) 196; Bosman, Leiden Bot. Ser. 14 (1991) 81. — Type: *King 388* (BM, P, SYD), New Guinea.

Rhizome terete, 4–8 mm thick, short-creeping, internodes 2–30 mm long, usually white waxy, roots densely set, forming a thick mat; vascular strands 11–21, without sclerified sheaths, sclerenchyma strands 50–100. *Rhizome scales* pseudopeltate, sometimes some peltate, sparsely to densely set, appressed to squarrosely spreading, ovate, narrowly ovate or triangular, 1.5–8 by 0.5–3 mm, margin entire to dentate, apex acute, clathrate or subclathrate, rarely with a hyaline margin, cells small, more or less isodiametric or longitudinally rectangular, central region glabrous or bearing multi-septate hairs. *Fronds* not or slightly dimorphic, sessile to stipitate, herbaceous to subcoriaceous (sometimes coriaceous). Stipe absent or to 12 cm long, 3–8 mm thick; lamina simple, narrowly ovate, elliptic or obovate to linear, 10–175 by 1.5–15 cm, index 4–20(–25), base cordate and auriculate to narrowly angustate, decurrent to a long wing forming two ridges at the base of the stipe, margin entire or undulate, occasionally irregularly lobed, apex rounded, acute to acuminate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct or prominent and distinct, 6–25 mm apart, more or less straight or zigzag, dichotomously branched near the margin; connecting veins 3–10, catadromous, forming more or less equally sized, sometimes irregularly shaped areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct or prominent and distinct, variously anastomosing, free veinlets simple to twice forked. *Sori* separate, round or elongate along veinlets, superficial or slightly immersed, 0.5–2.5 mm diam., mostly irregularly scattered on the smallest veinlets (occasionally in part on connecting veins), 5–55(–100) per sq. cm, on the whole surface of the lamina or absent from the basal parts for up to 0.9 of the total length of the lamina, present or absent from marginal and costal areoles; paraphyses simple uniseriate hairs with glandular top-cells, 2–4-celled. — **Fig. 17d.**

Distribution — Palaeotropics and subtropics (see Bosman 1991: f. 20). Throughout *Malesia*.

Habitat — Epiphytic, but also epilithic or terrestrial in various types of forest, sometimes in savannah but also in wet places in streambeds. Altitude to 2800 m.

Note — *Microsorium glossophyllum* is a form differing in the blackish narrow rhizome scales, but this character is variable and intermediates occur with the more brownish and wider scales. *Microsorium musifolium* is a form with wider fronds and more connecting veins and is connected with *Microsorium punctatum* by many intermediates.

23. *Microsorium rampans* (Baker) Parris

Microsorium rampans (Baker) Parris, Kew Bull. 41 (1986) 69; Bosman, Leiden Bot. Ser. 14 (1991) 100; Noot., Blumea 42 (1997) 355. — *Polypodium rampans* Baker, J. Linn. Soc. Bot. 15 (1877) 109. — Type: *Moseley, Challenger exp.* (K), New Guinea.

- Polypodium bamlerianum* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 8 (1910) 163. — *Pleopeltis bamlerianum* Alderw., Malayan Ferns Suppl. 1 (1917) 381. — *Microsorium bamlerianum* Copel., Gen. Fil. (1947) 196. — Type: *Bamler s.n.* (n.v.), New Guinea.
- Polypodium kingii* Copel., Philipp. J. Sc., Bot. 6 (1911) 89. — *Pleopeltis kingii* Alderw., Malayan Ferns Suppl. (1917) 396. — *Microsorium kingii* Copel., Gen. Fil. (1947) 196. — Type: *C. King* 122 (SYD, n.v.), New Guinea.
- Polypodium wobbenae* Brause, Bot. Jahrb. Syst. 49 (1912) 51. — *Pleopeltis wobbenae* Alderw., Malayan Ferns Suppl. 1 (1917) 382. — *Microsorium wobbenae* Copel., Gen. Fil. (1947) 197. — Type: *Schlechter* 16364 (K; iso P, S, UC, US), New Guinea.
- Pleopeltis myriocarpa* var. *schlechteriana* Alderw., Bull. Jard. Bot. Buitenzorg II, 11 (1913) 19. — Type: *Schlechter* 13920 (K, P), New Guinea.
- Polypodium tuanense* Copel., Philipp. J. Sc., Bot. 9 (1914) 8. — *Pleopeltis tuanensis* Alderw., Malayan Ferns Suppl. 1 (1917) 398. — *Microsorium tuanense* Copel., Gen. Fil. (1947) 196. — Type: *C. King* 384 (BM), New Guinea.

Rhizome dorsiventrally flattened, 1–4 mm wide, short- to long-creeping, internodes up to 3 cm long, not white waxy, roots sparsely set; vascular strands 7–9, with conspicuous sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* peltate or occasionally some pseudopeltate, densely set, appressed, round, elliptic, ovate, narrowly ovate or triangular, 0.5–3 by 0.3–1.5 mm, the margin entire to dentate, often eroded, apex rounded or acute, clathrate or subclathrate, central region glabrous. *Fronds* not or slightly dimorphic, simple or pinnatifid, stipitate, thin-herbaceous. Simple fronds: stipe 0.5–15 cm long, 0.5–1.5 mm thick; lamina narrowly elliptic, ovate to linear, 15–40 by 1.5–5.5 cm, index 4–15, base obtuse to narrowly angustate, decurrent to a long wing, margin entire, apex acute or acuminate to caudate, lower surface without acicular hairs. Dissected fronds: stipe 5–20 cm long, up to 1.5 mm thick; lamina round to ovate, 20–40 by 15–35 cm, index 1–1.5; widest below the middle, lobes 1–4 at each side, longest lobes at position 1–2 from base, 7.5–20 by 1.3–2.5 cm, index 3.5–12, widest at base to below the middle, connected by a 0.5–1.5 cm wide wing; apical lobe longer than upper lateral lobes, widest at base or just above base. *Venation*: veins prominent and distinct, 5–15 mm apart, more or less straight, dichotomously branched below to about the middle; a single connecting veins forming one row of large areoles, bordered by several smaller areoles; costal areole, if present, formed by smaller veins, included venation more or less immersed and indistinct, variously anastomosing, free veinlets simple to twice forked. *Sori* separate, round or elongate along veinlets, superficial or slightly immersed, 1–2.5 by 2–3(–35) mm, irregularly scattered on the smaller anastomosing veins, 1–20 per sq. cm, on the whole surface of the lamina, present in marginal and costal areoles, sometimes concentrated on a marginal vein; paraphyses simple uniseriate hairs with glandular topcells, 2–4 (–5)-celled.

Distribution — *Malesia*: New Guinea.

Habitat — Low epiphyte or rarely terrestrial in various types of primary and secondary forest. Shady places, often near streams. Altitude 0–1250 m.

Note — Occasionally most sporangia are arranged in long elongated sori along the margin of the lamina on the marginal connecting vein while only a few sori are scattered over the rest of the surface.

24. *Microsorum rubidum* (J. Sm.) Copel.

Microsorum rubidum (J. Sm.) Copel., Gen. Fil. (1947) 197; Noot., Blumea 42 (1997) 356. — *Drynaria rubida* J. Sm., J. Bot. (Hook.) 3 (1841) 397. — *Polypodium rubidum* Kunze, Bot. Zeitung (Berlin) (1848) 117. — Type: *Cuming* 241 (BM, K, L, P, US), Philippines.
Polypodium longissimum Blume, Enum. Pl. Javae (1828) 127, non Fée (1852); Backer & Posth., Varenfl. Java (1939) 222. — *Phymatodes longissima* J. Sm., Cat. Cult. Ferns (1857) 10; Tardieu & C. Chr. in Fl. Indo-Chine 7 (1941) 476. — *Pleopeltis longissima* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10. — *Phymatosorus longissimus* Pichi Serm., Webbia 28 (1973) 459. — Type: *Blume* 35 (L), Java.

Rhizome dorsiventrally flattened, 4–8 mm wide, medium- to long-creeping, internodes 1.5–10 cm long or longer, not white waxy, roots densely set; vascular strands 10–20, with (sometimes partly or weakly) sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* pseudopeltate, sparsely to densely set, appressed or slightly spreading, ovate or triangular, 3–6 by 1.3–3 mm, margin entire, apex acute or rounded, thinly clathrate, central region glabrous or bearing multiseptate hairs. *Fronds* not or slightly dimorphic, stipitate, herbaceous. Stipe 15–120 cm long, 3–12 mm thick; lamina pinnatifid, elliptic to narrowly elliptic, 30–120 by 8–60 cm, index 1.5–5; widest below to above the middle, base narrowly angustate, decurrent to a long wing, lobes 10–40 at each side, longest lobes at position 1–20 from the base, 7–40 by 0.7–3.5 cm, index 8–12, connected by a wing 0.1–1 cm wide, widest about or below the middle, apex acute to acuminate, or rounded; apical lobe longer than upper lateral lobes, 7–19 by 1.1–3.5 cm; margin entire, lower surface without acicular hairs. *Venation*: veins prominent and distinct, 4–10 mm apart, more or less straight; connecting veins anadromous, forming one row of small, inconspicuous, primary costal areoles bordered by one row of conspicuous large areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein; included veins more or less immersed and indistinct or prominent and distinct, marginal vein absent or obscure, free veinlets simple to twice forked. *Sori* separate, round, deeply sunken, visible as protrusions on the upper surface, 3–8 mm diam.; one sorus in each main areole, generally close to the costa, at most halfway to the margin, on the whole surface of the lamina or absent from the basal parts, paraphyses biseriate, non-clathrate. — **Fig. 17c.**

Distribution — Northern India to Japan, Taiwan and Indochina. Pacific: Admiralty Is.; Indian Ocean: Mauritius; Île Bourbon, Réunion. In *Malesia*: Sumatra, Java, Philippines, N Sulawesi, Talaud Is.

Habitat — Terrestrial, usually in wet places. Altitude usually low, but sometimes up to 1500 m.

Note — In absence of a rhizome not always easy to distinguish from *M. membranifolium*.

25. *Microsorum samarense* (J. Sm.) Bosman

Microsorum samarense (J. Sm.) Bosman, Leiden Bot. Ser. 14 (1991) 102; Noot., Blumea 42 (1997) 357. — *Diblemma samarense* J. Sm., J. Bot. (Hook.) 3 (1841) 399; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 154. — *Taenitis samarensis* Mett., Fil. Hort. Bot. Lips. (1856) 27. — *Colysis samarensis* J. Sm., Hist. Fil. (1875) 101. — Type: *Cuming* 332 (K; iso L, P, PC, Z), Philippines, Samar.

[*Drynaria tenuiloris* J. Sm., J. Bot. (Hook.) 3 (1841) 397, nom. nud.] — *Polypodium tenuilore* J. Sm. ex Mett., Farngatt. I. Polypodium (1856) 86. — *Pleopeltis tenuilore* T. Moore, Index Filic. (1857) 78. — *Colysis tenuilore* J. Sm., Hist. Fil. (1875) 101. — *Microsorium tenuilore* Copel., Fern Fl. Philipp. (1960) 483; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 154. — Type: *Cuming* 287 (BM, K, L, P, PC, Z).

Rhizome dorsiventrally flattened, 1–4 mm wide, short-creeping, internodes up to 11 mm long, not white waxy, roots sparsely set; vascular strands 5–10, with conspicuous sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* pseudopeltate, densely set, slightly spreading, ovate, narrowly ovate or triangular, (0.5–)1–3 by 0.5–1 mm, margin denticulate, apex acute, clathrate or subclathrate, central region glabrous. *Fronds* not or slightly dimorphic, stipitate, herbaceous to subcoriaceous. *Stipe* 0.5–4.5 cm long, 0.5–1.5 mm thick; lamina simple, linear, 25–45 by 0.5–1 cm, index 30–65, base truncate, margin entire, apex acuminate, lower surface with sparse to dense acicular hairs, especially around the sori. *Venation*: veins immersed and distinct, 5–13 mm apart, more or less straight, dichotomously branched below the middle to near the margin, a single connecting vein forming one row of large areoles parallel to the costa, bordered by several smaller areoles; costal areole, if present, formed by smaller veins; included venation more or less immersed and indistinct, variously anastomosing; free veinlets simple to twice forked. *Sori* separate, round or elongate, superficial or slightly immersed, 0.5–1.5 by 0.5–40 mm, mostly irregularly scattered on the smallest veinlets, 10–60 per sq.cm, on the whole surface of the lamina, present in marginal areoles, present or absent from costal areoles, sometimes concentrated near the margin or in a marginal longitudinal coenosorus; paraphyses simple uniseriate hairs with glandular topcells, 2- or 3-celled.

Distribution — *Malesia*: Philippines (common in western Samar).

Habitat — Epiphytic or epilithic in primary forest, limestone. Altitude 150–400 m.

Note — In some fronds the elongated sori are almost all concentrated on the marginal vein. This species is very close to *M. longissimum* and might be conspecific.

26. *Microsorium sarawakense* (Baker) Ching

Microsorium sarawakense (Baker) Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 295; Holttum, Revis. Fl. Malaya 2 (1954) 175; Noot., Blumea 42 (1997) 358. — *Polypodium sarawakense* Baker, Adansonia 22 (1887) 228. — *Pleopeltis sarawakensis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — *Neocheiropteris sarawakense* Parris, Sandakania 9 (1997) 81. — Type: *Hose* 125 (K), Borneo, Sarawak.

Polypodium forbesii Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 23. — *Pleopeltis forbesii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5. — Type: *Forbes* 2333 (BM, BO, US), Sumatra.

Polypodium peltatum Alderw., Malayan Ferns (1908) 632. — Type: *Scortechini* (n.v.).

Microsorium rizalense Copel., Philipp. J. Sc. 81 (1952) 42; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 154. — Type: *Ramos & Edaño* BS 29648 (K), Philippines, Luzon.

Rhizome terete, 1–2 mm thick, internodes (0.2–)1–8 cm, not white waxy, roots sparsely set; vascular strands 10–13, with or without sclerified sheaths, sclerenchyma strands 10–20. *Rhizome scales* peltate, densely set, appressed, round or elliptic, 0.8–1.2 by 0.5–1 mm, centrally dark, clathrate, margin hyaline, entire, irregular, often eroded, apex rounded, cells small, more or less isodiametric, central region glabrous.

Fronds not or slightly dimorphic, stipitate, herbaceous or subcoriaceous. Stipe 2.5–15 cm long, 1 mm thick; lamina simple, elliptic, 10–18 by 1.7–5 cm, index 2.5–5, base cuneate-angustate, margin entire, apex acute to caudate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct, 6–10 mm apart, more or less straight, dichotomously branched near the margin; connecting veins 2 or 3, not clearly distinct, anadromous or catadromous; in fertile fronds the first connecting vein often forming, or contributing to a distinct soral vein; included veins more or less immersed and indistinct, with the connecting veins forming a net of areoles, but not within the costal areole, free veinlets simple to twice forked. *Sori* separate, round, superficial or slightly immersed, 1.2–4 mm diam.; in 3 or 4 rows between costa and margin, in 2, often alternating rows between the veins on the whole surface of the lamina, paraphyses simple uniseriate hairs with glandular topcells.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Java, Borneo, Philippines (Luzon).

Habitat — Terrestrial or low to high epiphyte, often in humid places. Altitude 500–1500 m.

Note — Specimens from the Peninsula Malaysia have a rather regular venation, and small sori regularly in two rows between the veins, the rows clearly slanted upwards, following the pattern of the veins. Specimens from other localities have larger sori, more often in alternating rows between the veins, resulting in rows apparently slanted downwards, across the pattern of the veins.

27. *Microsorium scolopendria* (Burm. f.) Copel.

Microsorium scolopendria (Burm. f.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 112; W.C. Shieh, Fl. Taiwan 1 (1994) 504; Noot., Blumea 42 (1997) 361. — *Polypodium scolopendria* Burm. f., Fl. Indica (1768) 232; Link, Hort. Berol. (1833) 122. — *Polypodium phymatodes* L., Mant. Pl. (1771) 306; Blume, Enum. Pl. Javae (1828) 125, nom. illeg. — *Phymatodes scolopendria* Ching, Contr. Inst. Bot. Nat. Acad. Peiping 2 (1933) 63; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 473; Brownlie in Fl. Nouv. Caléd. et Dép. 3 (1969) 292; E.H. Walker, Fl. Okinawa and Ryukyu (1976) 114. — *Phymatosorus scolopendria* Pichi Serm., Webbia 28 (1973) 460; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 29. — Type: *Herb. Hermann* (n.v.), Ceylon.

Polypodium hemionites Cav., Descr. Pl. (1802) 248. — Type: *Née s.n.* (BM, fragment), Marianas. *Polypodium phymatodes* var. *partitum* Blume, Enum. Pl. Javae (1828) 128. — Type: *Blume s.n.* (L), Java.

Phymatodes vulgaris C. Presl, Tent. Pterid. (1836) 196. — *Drynaria vulgare* J. Sm., J. Bot. (Hook.) 3 (1841) 397. — Type: *Cuming 201* (BM, K, P), Philippines.

Polypodium excavatum Roxb., Hort. Bengal. (1814) 75; Calc. J. Nat. Hist. 4 (1844) 485; Morton, Contr. Nat. Herb. 38, 7 (1974) 343. — Type: Rumphius, Herb. Amboin. 6: 80, t. 35, f. 2 (fide Morton, l.c.).

Pteris lobata Roxb., Calc. J. Nat. Hist. 4 (1844) 504, nom. illeg., non Goldm. (1843); Morton, Contr. Nat. Herb. 38, 7 (1974) 370. — Type: *Chr. Smith s.n.* (BR, fide Morton, l.c.), Moluccas.

Rhizome terete, 8–7 mm thick, internodes 1–9 cm long, roots sparsely to densely set; vascular bundles 9–30, with inconspicuous sclerified sheaths, sclerenchyma strands 10–100. *Rhizome scales* peltate, occasionally some pseudopeltate, sparsely to densely set, appressed to distinctly spreading, ovate, narrowly ovate or triangular, 2–7 by 0.6–1.4 mm, margin at base irregularly lacerate, in the acumen denticulate, apex acute (often caducous), clathrate or subclathrate, cells longitudinally rectangular in

the narrow apical part, central region glabrous or bearing multiseptate hairs. *Fron*ds not or slightly dimorphous, simple or pinnatifid, stipitate, herbaceous. Simple fronds: stipe 2–30 cm long, 0.8–2.3 mm thick, lamina elliptic to narrowly elliptic, 8–45 by 2–8 cm, index 5–6, base cuneate or cuneate-angustate, margin entire, apex acute to acuminate, undersurface without acicular hairs. Pinnatifid fronds: stipe 4–55 cm long, 0.8–7.2 mm thick; lamina ovate, 14–41 by 9–30 cm, index 1–1.5; widest below to about the middle, lobes 1–9 at each side, longest lobes at position 1–2 from base, 5–20 by 0.7–4 cm, index 5–10, widest at the base to about the middle, connected by a wing 0.5–2.3 cm wide; upper lobes at an angle of 35–50° to the apical lobe; apical lobe longer than upper lateral lobes, 3–20 by 0.8–5 cm, widest at or just above the base. *Venation*: veins \pm immersed and indistinct or prominent and distinct, 4–12 mm apart, more or less straight or zigzag, dichotomously branched near the margin or about the middle or each costal areole giving rise to two lateral veins, thus the lateral veins seemingly branching at or near the costa; connecting veins 1–4; ana- or catadromous, forming several rows of equally sized areoles or one row of conspicuous, large areoles, sometimes also a row of small costal areoles, in fertile fronds the first connecting vein often forming, or contributing to a distinct soral vein; included venation \pm immersed and indistinct, sometimes more conspicuous, variously anastomosing, forming a dense reticulation with smaller areoles, free veinlets simple or once forked. *Sori* separate, round or elongate, deeply sunken, visible as protrusions on the upper surface, 1–6.5 by 6.5–15 mm, 1–3 rows between costae and margin, one sorus in, or just outside, each primary costal areole, on the whole surface of the lamina or absent from the basal parts; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — Paleotropical. Throughout *Malesia*.

Habitat — Epiphytic, epilithic or terrestrial, in all kinds of habitats. Altitude from sea level to 2100 m.

Note — See note 1 under *M. papuanum*.

28. *Microsorium sibomense* Copel.

Microsorium sibomense Copel., Gen. Fil. (1947) 196; Noot., Blumea 42 (1997) 372. — *Polypodium sibomense* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 10 (1912) 340. — Type: *Bamler* 52 (BM, K, US), New Guinea.

Polypodium tenuinerve Copel., Philipp. J. Sc., Bot. 9 (1914) 7. — *Microsorium tenuinerve* Copel., Gen. Fil. (1947) 196. — Type: *C. King* 364 (n.v.).

Rhizome terete, 1.6–3 mm thick, internodes 1.2–4.5 cm long or longer, not white waxy, roots sparsely set; vascular strands 15–25, without sclerified sheaths, sclerenchyma strands 15–50. *Rhizome scales* peltate, sparsely to densely set, appressed to slightly spreading, narrowly ovate or triangular, 3–6 by 0.5–2 mm, margin denticulate, sometimes only very slightly so, apex acute, clathrate or subclathrate, cells longitudinally rectangular, central region glabrous. *Fron*ds not or slightly dimorphic, stipitate, membranaceous to thin-herbaceous. Stipe 6–55 cm long, 1.5–3 mm thick; lamina pinnatifid, broadly ovate to ovate, 18–70 by 13–45 cm, index 1–3, widest below to about the middle, base cuneate to cuneate-angustate, lobes 2–20 at each side, longest lobes at position 1–4 from base, connected by a wing 1–10 mm wide, widest below to about the middle, 10–20 by 0.8–2.3 cm, index 8–12, apex acute to long-acuminate; apical lobe longer than upper lateral lobes, 6–15 by 0.9–1.7 cm, widest about the

middle; margin entire to undulate, lower surface without acicular hairs. *Venation*: veins slightly prominent and distinct, 4–8 mm apart, catadromous; connecting veins forming one row of small, inconspicuous, primary costal areoles, bordered by conspicuous large areoles; in fertile fronds the first connecting vein often forming, or contributing to, a distinct soral vein; included veins more or less immersed and indistinct or prominent and distinct, marginal vein absent, free veinlets simple to twice forked. *Sori* separate, round, superficial or slightly immersed, 1–3 mm diam., in 1 or 2 rows between midrib and margin, generally close to the costa, at most halfway to the margin, on the whole surface of the lamina or absent from the basal parts; paraphyses simple uniseriate hairs with glandular topcells.

Distribution — *Malesia*: New Guinea.

Habitat — Altitude 50–2400 m.

Note — This species closely resembles *M. powellii* but differs in the rhizome scales, the size, and the number of pinnae.

29. *Microsorium sopusense* Bosman

Microsorium sopusense Bosman, Leiden Bot. Ser. 14 (1991) 103, t. 22; Noot., Blumea 42 (1997) 363. — Type: *Hennipman 5619* (L), Celebes.

Rhizome dorsiventrally flattened, 1–3 mm wide, short-creeping, internodes up to 25 mm long, not white waxy, roots densely set; vascular strands 8–12, with sclerified sheaths, sclerenchyma strands absent. *Rhizome scales* peltate, sparsely set, appressed or slightly spreading, narrowly ovate or triangular, (2–)3.5–6 by 0.5–1 mm, margin denticulate, apex acute, clathrate or subclathrate, central region glabrous. *Fronds* not or slightly dimorphic, sessile to stipitate, thin-herbaceous. Stipe absent or up to 0.5 cm long, 1–2.5 mm thick; lamina simple, linear, 60–75 by 2–3 cm, index 20–40, base cuneate-angustate to narrowly angustate, gradually decurrent into two ridges at the base of the stipe; margin entire, apex acuminate, the lower surface without acicular hairs. *Venation*: veins prominent and distinct, 6–10 mm apart, zigzag, dichotomously branched near the margin; connecting veins 3 or 4, ana- or catadromous, forming equally sized, sometimes irregularly shaped, areoles, sometimes also a row of small primary costal areoles; included veins more or less immersed and indistinct, variously anastomosing, free veinlets simple. *Sori* separate, round, superficial or slightly immersed, 1 mm diam., mostly irregularly scattered on the smallest veinlets, 2 per veinlet, 15–30 per sq. cm, absent from the basal parts for 0.3–0.7 of the total length of the lamina, present in marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 2- or 3-celled. — **Fig. 17a.**

Distribution — *Malesia*: Central Sulawesi (very common in the Sopa valley).

Habitat — Epiphytic, in primary forest, often near streams. Altitude 1000–1200 m.

30. *Microsorium superficiale* (Bedd.) Ching

Microsorium superficiale (Bedd.) Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 299. — *Polypodium superficiale* Blume, Enum. Pl. Javae (1828) 123. — *Pleopeltis superficialis* Bedd., Ferns Brit. India (1865) t. 75. — *Colysis superficialis* J. Sm., Hist. Fil. (1875) 101. — *Neocheiropteris superficialis* Bosman, Leiden Bot. Ser. 14 (1991) 121. — Type: *Blume s.n.* (L), Java. *Pleopeltis superficialis* var. *latifrons* Bedd., J. Bot. 31 (1893) 226. — Type: *Scortechini s.n.* (n.v.).

Rhizome dorsiventrally flattened, 1–5 mm wide, short- to long-creeping, internodes 3–40 mm long, not white waxy, bearing scales and hairs, roots sparsely set; vascular strands 6–13, with sclerified sheaths; sclerenchyma strands 0–15, situated dorsally of the vascular cylinder. *Rhizome scales* pseudopeltate, more or less densely set, appressed to distinctly spreading, ovate, narrowly ovate or triangular, 1–6.5 by 0.5–2.5 mm, margin entire to dentate, sometimes with small triangular lobes, apex rounded to acute, clathrate or subclathrate, sometimes with hyaline margin, cells longitudinally rectangular towards the apex, central region glabrous or bearing multiseptate hairs. *Fronde*s not or slightly dimorphic, sessile to stipitate, herbaceous to subcoriaceous. Stipe absent or up to 20 cm long, 0.5–2 mm thick; lamina simple, narrowly elliptic, ovate, deltoid or linear, 3–40(–60) by 0.5–6 cm, index 2–30, base abruptly cuneate to narrowly angustate, occasionally with some irregular triangular lobes, decurrent to a long wing, forming two ridges at the base of the stipe, margin entire, sinuate to undulate, apex acute to acuminate, lower surface without acicular hairs. *Venation*: veins more or less immersed and indistinct to prominent and distinct, 3–10 mm apart, zigzag, dichotomously branched near the margin or each costal areole giving rise to two lateral veins, thus the lateral veins seemingly branching at or near the costa; connecting veins 1–6, catadromous, forming equally sized areoles or the costal areole bordered by several smaller areoles; included veins more or less immersed and indistinct, in part sometimes forming a prominent vein parallel to each lateral vein, free veinlets simple to twice forked. *Sori* separate, round or sometimes slightly elongate, superficial or slightly immersed, 1–2.5 mm diam., mostly 2–4 on a connective vein (occasionally on lesser veins), sometimes irregularly scattered, 3–15 per sq. cm, on the whole surface of the lamina or absent from the basal parts for 0–0.75 of the total length of the lamina, present or absent in marginal and costal areoles; paraphyses simple uniseriate hairs with glandular topcells or clathrate and peltate (sometimes in young sori). — **Fig. 17b.**

Distribution — India to Japan and Indochina; in *Malesia*: Sumatra, Peninsular Malaysia, Java.

Habitat — Low epiphyte in primary or secondary forest. Altitude 400–2600 m.

Note — *Microsorium zippelii* differs mainly in the prominent veins, and might be a variety of the present species.

31. *Microsorium zippelii* (Blume) Ching

Microsorium zippelii (Blume) Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 308; Noot., Blumea 42 (1997) 371. — *Polypodium zippelii* Blume, Fl. Javae. Filic. (1829) 172, t. 80. — *Pleopeltis zippelii* T. Moore, Index Filic. II (1862) 348. — *Polypodium heterocarpum* var. *zippelii* Baker in Hook. & Baker, Syn. Fil. (1868) 360. — *Colysis zippelii* J. Sm., Hist. Fil. (1875) 100. — *Neocheiropteris zippelii* Bosman, Leiden Bot. Ser. 14 (1991) 123. — Type: *Zippelius s.n.* (L), Java.

Polypodium oxyphyllum Kunze, Bot. Zeitung (Berlin) 6 (1848) 116. — Syntypes: Zollinger 2029 (L), 2332 (BM, L, LE, P, PR), Java.

Polypodium luzonicum Copel., Philipp. J. Sc. 1, Suppl. (1906) 162, t. 23. — *Pleopeltis luzonica* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7. — *Microsorium luzonicum* Tagawa, Acta Phytotax. Geobot. 16 (1955) 51. — Type: *Copeland 1918* (P, S, SING, US), Philippines, Luzon.

[*Drynaria subfalcata* J. Sm., J. Bot. (Hook.) 3 (1841) 397, nom. nud. — *Bathmium?* *subfalcatum* Fée, Gen. Filic. (1850–1852) 287, nom. nud.: *Cuming 113.*]

Rhizome terete, 1–3(–4) mm thick, long-creeping, internodes 10–70 mm long, not white waxy, roots densely set; vascular strands 11–17, with sclerified sheaths, sclerenchyma strands 50–100. *Rhizome scales* pseudopeltate, densely set, distinctly spreading, narrowly ovate or triangular, 2.5–6.5 by 1–2 mm, margin denticulate to dentate, apex acute, clathrate or subclathrate, cells longitudinally rectangular in apical part, central region glabrous. *Fronds* not or slightly dimorphic, stipitate, herbaceous to firm-herbaceous. Stipe 0.8–8 cm long, 0.8–3.2 mm thick; lamina simple, narrowly elliptic to obovate, 6.5–65 by 1–8 cm, index 5.5–14, base narrowly angustate, decurrent to a long wing, margin entire, occasionally sinuate, apex acuminate, lower surface without acicular hairs. *Venation*: veins prominent and distinct, 4–13 mm apart, more or less straight or zigzag, dichotomously branched near the margin; connecting veins 3–7, cata- or anadromous, forming equally sized areoles, included veins more or less immersed and indistinct or prominent and distinct, variously anastomosing, sometimes forming a distinct vein parallel to each vein, free veinlets simple to twice forked. *Sori* separate, round or elongated, 1.5–2 by 2–4 mm, superficial or slightly immersed, on the connecting veins, 1 (or 2) per vein, in two irregular rows between each pair of veins, 2–10 per sq.cm, on the whole surface of the lamina, absent in marginal areoles, generally present in costal areoles; paraphyses simple uniseriate hairs with glandular topcells, 3- or 4-celled.

Distribution — Northern India to Indochina, southern China. In *Malesia*: Peninsular Malaysia (Pahang), Sumatra, Java, Lesser Sunda Islands, Borneo, Philippines (Luzon), Sulawesi, New Guinea.

Habitat — Generally a (low) epiphyte in dry or wet forest, sometimes epilithic on sandstone or limestone. Altitude 200–1700 m.

Note — This species might be a variety of *M. superficiale*.

PARASELLIGUEA

(P. H. Hovenkamp)

Paraselliguea Hovenkamp, *Blumea* 42 (1997) 485. — Type species: *Polypodium leucophorum* Baker.

A monotypic genus close to *Selliguea*.

Paraselliguea leucophora (Baker) Hovenkamp

Paraselliguea leucophora (Baker) Hovenkamp, *Blumea* 42 (1997) 485. — *Polypodium leucophorum* Baker, J. Linn. Soc. (Bot.) 22 (1886) 229. — *Pleopeltis leucophora* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7. — Type: *Hose* 129 (K), Borneo.

Pleopeltis melanocaulos Alderw., Bull. Jard. Bot. Buitenzorg II, 11 (1913) 19. — Type: *Amdjah* 266 (BO, iso L), Borneo.

Rhizome 2–3 mm thick, slightly glaucous, sinuous, long-creeping, internodes 4–5 cm long, branches arising near and opposite to the fronds; vascular strands 7–12, without sclerified bundle sheaths, sclerenchyma strands 20–many, scattered, ground tissue not sclerified. *Rhizome scales* peltate, spreading to squarrose, 10–12 mm long, reddish brown, base short-dentate, acumen entire, completely taken up by a thick

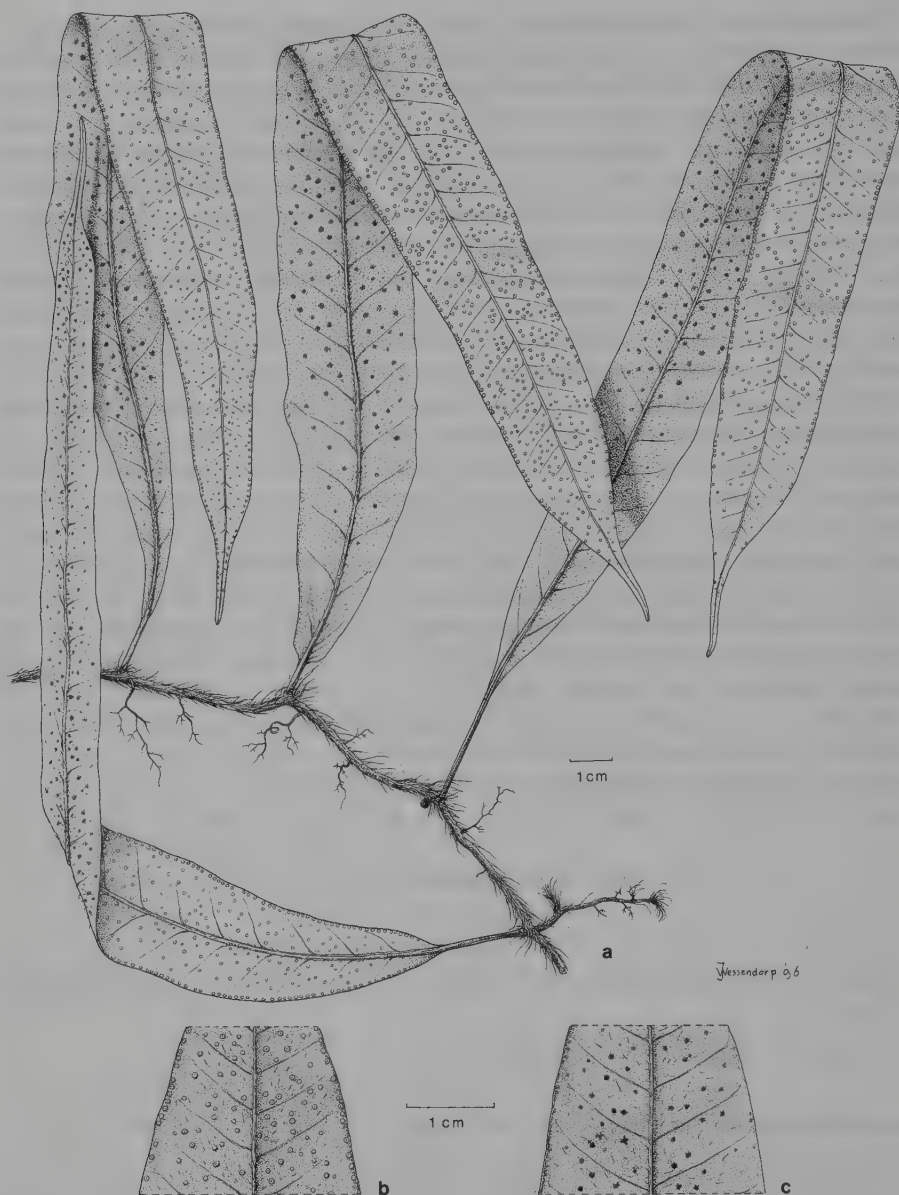


Fig. 18. *Paraselliguea leucophora* (Baker) Hovenkamp. a. Habit; b. upper surface of the lamina showing hydathodes with persistent calcareous scales; c. lower surface of lamina (Hallier 3341). Drawing by J. Wessendorp. Reproduced from Blumea 42 (1997).

midrib, apex filiform. *Fronds* monomorphic, simple, to 44 by 4.8 cm, widest near or above the middle, base usually slightly unequally cuneate, margin entire, thin and translucent, apex acuminate to caudate, both sides with scattered, 1–2 mm long, 5–8-

celled acicular hairs, sometimes with a denser cover of much shorter 2-celled hairs as well. *Venation*: main veins not raised on upper surface, connecting veins forming 6 or 7 rows of more or less rectangular areoles, veinlets branching and anastomosing, free veinlets excurrent and recurrent, marginal row of excurrent free veins distinct. Hydathodes distinct, with persistent calcareous scales. *Sori* to 1 mm wide, scattered, c. 4 in each areole. Sporangia short-stalked, capsules c. 0.3 mm long, with 10–13 indurated annulus cells. Spores brown, 54 by 30–40 μm , densely set with spines. — **Fig. 18.**

Distribution — *Malesia*: Borneo.

Habitat — Epiphytic, in forest; scattered, but apparently not rare in its stations. Altitude 200–450 m.

Note — The most distinctive characters are the long-sinuous rhizome, the scattered, deciduous, long-subulate scales, the hairy lamina surface and the irregularly scattered sori. On the basis of each of these characters it could be accommodated in the genus *Selliguea*, but it would remain an aberrant species there. It combines characters that otherwise occur in widely disparate species.

Taxonomy — *Paraselliguea leucophora* has been overlooked in all generic reclassifications of the *Polypodiaceae*. Informally, it has been assigned to *Microsorium* and *Crypsinus* (= *Selliguea*).

PLATYCERIUM

(E. Hennipman & M. C. Roos)

Platycerium Desv., Mém. Soc. Linn. Paris 6 (1827) 213; Blume, Fl. Javae Fil. (1829) 43; C. Presl. Tent. Pterid. (1836) 239; Hook., Gen. Fil. (1842) t. 80B; C. Presl, Epim. Bot. (1851) 152; Hook., Spec. Fil. 5 (1864) 282; Bedd., Ferns Brit. India (1866) 108; J. Sm., Ferns Brit. & For. (1866) 120; Baker, Syn. Fil. (1868) 425; J. Sm., Hist. Fil. (1875) 122; Bedd., Suppl. Ferns Brit. India (1892) 444; Copel., Polypod. Philipp. (1905) 138; Alderw., Malayan Ferns (1908) 707; Ridl., J. Mal. Br. Roy. As. Soc. 4 (1926) 109; Copel., Univ. Calif. Publ. Bot. 16 (1929) 103; Backer & Posth., Varenfl. Java (1939) 246; Ching, Sunyatsenia 5 (1940) 256; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 445; Copel., Gen. Fil. (1947) 179; Pichi Serm., Webbia 9 (1953) 434; Holtum, Revis. Fl. Malaya 2 (1955) 137; Subcommittee Pteridophyta, Taxon 3 (1954) 70; Copel., Fern Fl. Philipp. (1960) 457; Joe, Bailey 12 (1964) 69; Morton, Bailey 12 (1964) 36; De Jonch., Blumea 15 (1967) 445; Joe Hoshiz., Am. Fern J. 60 (1970) 144; Biotropica 4 (1972) 93; De Jonch., Blumea 22 (1974) 55; Hennipman & Roos, Monogr. Platycerium (1982); Hoshiz. & Price, Amer. Fern J. 80 (1990) 53; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 209. — [*Neuroplatyceros* Pluk., Anlh. Bot. (1705) 151.] — *Acrostichum* L. subg. *Neuroplatyceros* Endl., Gen. Pl. 1 (1836) 59. — *Neuroplatyceros* Fée, Mém. Foug. 2. *Acrostichum* (1845) 25; Mém. Foug. 5. Gen. Filic. (1850–1852) 62. — *Neuroplatyceros* Fée subg. *Platyceria* Fée, Mém. Foug. 2. *Acrostichum* (1845) 104. — *Platycerium* Desv. subg. *Platyceria* T. Moore, Ind. Filic. (1857) 22. — *Acrostichum* L. subg. *Platycerium* Kunze, Bot. Zeitung (Berlin) 6 (1848) 102. — *Platycerium* Desv. sect. *Euplatycerium* Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1902) 339; Alderw., Malayan Ferns (1908) 707; Malayan Ferns Suppl. (1917) 421. — Type species: *Acrostichum alcorni* Sw. (= *Platycerium alcorni*). *Alcornium* Gaudich., Freycin. Voy. Bot. (1826) 48, nom. illeg.; Underwood, Mem. Torrey Bot. Club 6 (1899) 275; Bull. Torrey Bot. Club 30 (1903) 672; 32 (1905) 588. — Type species: *Alcornium vulgare* Gaudich., nom. illeg. (= *Platycerium bifurcatum*).

Neuroplatyceros Fée subg. *Scutigera* Fée, Mém. Foug. 2. *Acrostichum* (1845) 104; Mém. Foug. 5. Gen. Filic. (1850-1852) 62. — *Platycerium* Desv. subg. *Scutigera* T. Moore, Ind. Filic. (1857) 22; Alderw., Malayan Ferns (1908) 707; Malayan Ferns Suppl. (1917) 421. — Type species: *Neuroplatyceros biformis* (Blume) Fée (= *Platycerium coronarium*).

Epiphytic or occasionally epilithic ferns of very striking appearance, growing solitary or in clusters. *Rhizome* hidden, short, with fronds clustered. *Rhizome scales* basifixed to peltate, variously set with glandular and non-glandular, simple and branched, uni- to multicellular hairs. *Fronds* of two types: persistent base fronds forming a distinct basket and deciduous foliage fronds, simple to variously dichotomously forked, set with stellate hairs. Base fronds remaining green or withering when old, lower part appressed, upper part closely appressed to spreading, entire to forked several times. Foliage fronds usually 2–several present at a time, erect to pendulous, forked up to 7 times. *Sori* forming large soral patches, set on a fine mesh of narrowly linear receptacles. Spores with an inconspicuous perispore, smooth or nearly smooth. — **Fig. 19–21.**

Distribution — Predominantly Paleotropical, one isolated species in tropical South America.

Notes — 1. Baskets. The foliage fronds are articulated to the rhizome, and leave a distinct scar on the phyllopodium when they are shed. The base fronds are not articulate and are retained on the rhizome, where they gradually are covered with later base fronds, and ultimately disintegrate inside the basket. The most recent base fronds form an open or closed basket in which humus collects, and in which the plant sends out roots. The baskets may also provide the substrate for other epiphytes. At their base, the base fronds contain spongy water-storage tissue and may reach thicknesses of up to 2 cm.

2. Some species may form large clusters of many different plants, which are formed either by long rhizome runners producing new plants at their apex, or by new plants growing from root tips.

3. Many of the species are very popular in cultivation throughout the world. *Platycerium bifurcatum* is frequently cultivated in Java, and is often seen for sale on roadside stalls near, e.g., the mountain garden Tjibodas (Java).

Taxonomy — *Platycerium* is a very distinct genus, characterised by the frond dimorphism, the formation of a basket of base fronds and the dichotomously divided fronds. The subdivision of *Platycerium* is the subject of some dispute. The Malesian species can be arranged in three distinct groups, based mainly on growth habit and morphology of the fronds. The *P. bifurcatum*-group (forming large clumps of different plants by way of root proliferation, with fertile patches terminal on the frond segments); the *P. coronarium*-group (growing as single plants, with soral patches occupying specialised lobes near the basis of the fronds), and the 'Giant staghorns' (forming often very large, single plants, with soral patches in the sinuses of the fronds). Hennipman & Roos (1982) present a cladistic analysis in which the *P. coronarium*-group and the *P. bifurcatum*-group are linked together, and the 'Giants' are linked to species from Madagascar and South America. In contrast, Hoshizaki (1972) and Hoshizaki & Price (1990) present convincing arguments why the *P. coronarium*-group should be linked to the 'Giants' instead, with the Afro-American species forming a separate group.

Platycterium is closely related to *Pyrrosia*, with which it shares the peculiar indument. It has been classified as a separate family (*Platycteriaceae* Ching), and together with *Pyrrosia* it is treated as a subfamily (*Platycterioideae*) by Hennipman et al. (1990).

KEY TO THE SPECIES

- 1a. One soral patch on each foliage frond, situated on a separate, stalked lobe, rhizome scales with a wide flabelloid margin 2
- b. Soral patches 2—many on each foliage frond, situated on the lamina of the frond, rhizome scales without wide, flabelloid margin 3
- 2a. Foliage fronds long, pendulous, fertile lobe reniform, base fronds with upper part deeply lobed, veins immersed **2. *P. coronarium***
- b. Foliage fronds erect, fertile lobe obovate or elliptical, rarely lobed, base fronds with upper part entire or sinuose, veins prominent **5. *P. ridleyi***
- 3a. Soral patches many on each foliage frond, situated on the ultimate lobes 4
- b. Soral patches 2 on each foliage frond, situated in the sinuses near the base of the frond, ultimate lobes sterile 5
- 4a. Upper part of base fronds entire, foliage fronds erect **1a. *P. bifurcatum* subsp. *bifurcatum* var. *hillii***
- b. Upper part of base fronds lobed, foliage fronds pendulous **1b. *P. bifurcatum* subsp. *willinckii***
- 5a. Foliage frond symmetrical, with two equal main lobes **3. *P. grande***
- b. Foliage fronds asymmetrical, with two unequal main lobes 6
- 6a. Both soral patches with well-developed, forked, lateral sterile lobes **4. *P. holttumii***
- b. Lateral soral patch with very short, simple, lateral sterile lobes ... **6. *P. wandae***

1. *Platycterium bifurcatum* (Cav.) C. Chr.

Platycterium bifurcatum (Cav.) C. Chr., Index Filic. (1906) 496; Hennipman & Roos, Monogr. *Platycterium* (1982) 90, f. 17, 19. — *Platycterium bifurcatum* Backer & Posth., Varenfl, Java (1939) 217, p.p.; Joe, *Baileya* 12 (1964) 83, f. 36a, f. 55: 9, 10, 12–14, 19; De Jonch., *Blumea* 15 (1967) 450, f. 3; Joe Hoshiz., *Amer. Fern J.* 60 (1970) pl. 19, f. 23; *Biotropica* 4 (1972) 94, pl. 1: 2, pl. 2: 10, pl. 3: 10, pl. 6: 14, pl. 7: 10, pl. 8: 10. — *Acrostichum bifurcatum* Cav., *Anal. Hist. Nat.* 1 (1799) 105; *Descr. Pl.* (1802) 241. — *Alcicornium bifurcatum* Underw., *Bull. Torrey Bot. Club* 32 (1905) 594. — *Platycterium bifurcatum* (Cav.) C. Chr. var. *normale* Domin, *Bibl. Bot.* 85 (1915) 196, comb. illeg. — *Platycterium bifurcatum* (Cav.) C. Chr. var. *bifurcatum* Joe, *Baileya* 12 (1964) 84, f. 36b–h, f. 55: 14. — Type: *Née s.n.* (MA, n.v.), Australia.

Alcicornium vulgare Gaudich., *Freycin. Voy. Bot.* (1826) 307, nom. illeg. — Type: not traced.

Platycterium angustatum Desv., *Mém. Soc. Linn. Paris* 6 (1827) 213. — Type: *Anonymous* (P. herb. Desvaux), Australia.

Platycterium sumbawense H. Christ, *Warb. Monsunia* 1 (1900) 64; Alderw., *Malayan Ferns* (1908) 709; H. Christ, *Ann. Jard. Bot. Buitenzorg Suppl.* 3 (1910) 8, pl. 1; Alderw., *Malayan Ferns Suppl.* (1917) 422. — *Alcicornium sumbawense* Underw., *Bull. Torrey Bot. Club* 32 (1905) 596. — Type: *Warburg 17266* (B), Sumbawa.

Acrostichum alcicorne and homotypic synonyms, p.p., auct., non Swartz (1801): *Blume, Enum. Pl. Javae* (1828) 10; *Fl. Javae Fil.* (1828) 46; Fée, *Mém. Foug.* 2. *Acrostichum* (1845) 120, p.p.;

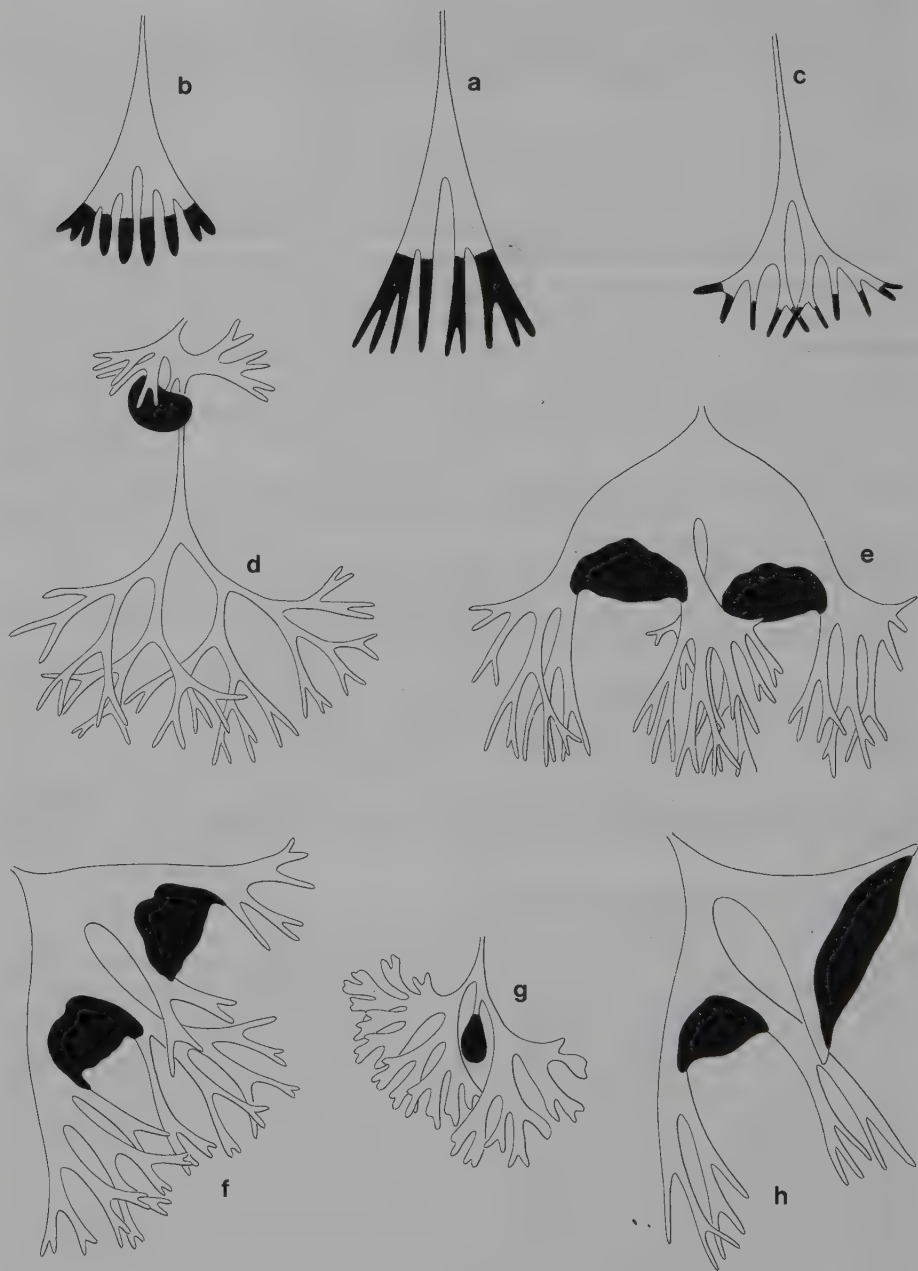


Fig. 19. *Platycerium*. Outlines of foliage fronds. — a. *P. bifurcatum* (Cav.) C. Chr. subsp. *bifurcatum*. — b. *P. bifurcatum* subsp. *bifurcatum* var. *hillii* (T. Moore) Domin. — c. *P. bifurcatum* subsp. *willinckii* Hennipman & Roos. — d. *P. coronarium* (König ex Müller) Desv. — e. *P. grande* (Fée) Kunze. — f. *P. holttumii* De Jonch. & Hennipman. — g. *P. ridleyi* H. Christ. — h. *P. wandae* Racib. — Redrawn after Hennipman & Roos (1982).

Kunze, *Linnaea* 23 (1850) 474; C. Presl, *Epim. Bot.* (1851) 153; Mett., *Fil. Hort. Bot. Lips.* (1856) 26, pl. 4: 1-3; Hook., *Spec. Fil.* 5 (1864) 282; Baker, *Syn. Fil.* (1867) 425; Racib., *Pterid. Buitenzorg* (1898) 57.

a. subsp. *bifurcatum*

Rhizome scales basifixed to peltate, 1.5–11 by 0.3–1.3 mm, index 3–8(–25), widest at the base or occasionally at or above the middle, margin with hairs to 1 mm long, midrib present. *Fronds*: base fronds withering, erect or appressed when old, 18–60 by 8–45 cm, upper part entire to dichotomously forked with unequal lobes, veins immersed, basal fringe inconspicuous. Foliage fronds maturing subsequently, erect, spreading or pendulous, usually asymmetrical, 25–100 cm long, 2–5 × forked. *Soral patches* 1–10, apically on the lobes, 1–22 cm long; sporangia with 18–22 indurated annulus cells. Spores 64 per sporangium. — **Fig. 19a.**

Habitat — Epiphytic and epilithic, growing in clusters.

Note — This subspecies is divided into two varieties, of which only one occurs in Malesia.

var. *hillii* (T. Moore) Domin

Platyserium bifurcatum (Cav.) C. Chr. subsp. *bifurcatum* var. *hillii* (T. Moore) Domin, *Bibl. Bot.* 85 (1915) 197, f. 4; Hennipman & Roos, *Monogr. Platyserium* (1982) 91. — *Platyserium hillii* T. Moore, *Gard. Chron.* 10 (1878) 51, 429, f. 6, 74, 75; Joe, *Baileya* 12 (1964) 92, f. 41, 55: 15–18; Joe Hoshiz., *Amer. Fern J.* 60 (1970) pl. 18: 4, pl. 19: 13, 24; *Biotropica* 4 (1972) 94, pl. 2: 11, pl. 3: 11, pl. 6: 15, pl. 7: 11, pl. 8: 11; Jones & Clemesha, *Austr. Ferns* (1976) 234, f. 215, idem ed. 2 (1980) 181, f. 244. — *Platyserium alaicorne* Desv. var. *hillii* F.M. Bailey, *Syn. Queensl. Fl.* (1883) 724; *Queensl. Fl.* 6 (1902) 1995. — *Alaicornium hillii* Underw., *Bull. Torrey Bot. Club* 32 (1905) 595. — Type: W. Hill (K).

Rhizome scales widest near the middle, with hairs up to 0.3 mm long. *Fronds*: base fronds 20–40 by 12–24 cm, upper part rounded, margin entire. Foliage fronds erect, usually symmetrical, 25–70 cm long, 2–5 × forked, ultimate segments angustate, elliptical to obovate, sparsely hairy. Hairs with 9–15 rays to 0.3 mm long. — **Fig. 19b.**

Distribution — *Malesia*: New Guinea. Outside Malesia in eastern Australia.

Habitat — Epiphytic, rarely epilithic in primary and secondary forest, or in more open vegetation (savannah-forest). Altitude from sea level to 1200 m.

b. subsp. *willinckii* Hennipman & Roos

Platyserium bifurcatum (Cav.) C. Chr. subsp. *willinckii* Hennipman & Roos, *Monogr. Platyserium* (1982) 92, f. 18, pl. 3. — *Platyserium willinckii* T. Moore, *Gard. Chron.* 3 (1875) 302, f. 56 (excellent); Alderw., *Malayan Ferns* (1908) 710; *Malayan Ferns Suppl.* (1917) 422; Joe, *Baileya* 12 (1974) 110, f. 50–54, 55: 1–7; Joe Hoshiz., *Amer. Fern J.* 60 (1970) pl. 19: 12, 21; *Biotropica* 4 (1972) 94, pl. 1: 3, 6, pl. 2: 8, pl. 3: 8, pl. 6: 8, pl. 7: 8, pl. 8: 8; *Fern Growers Man.* (1979) 210, c. fig. — *Alaicornium willinckii* Underw., *Bull. Torrey Bot. Club* 32 (1905) 596. — Type: Willinck (K, not traced).

Rhizome scales widest near the base, with hairs up to 0.2 mm long. *Fronds*: base fronds up to 70 by 50 cm, upper part elliptical, up to 4 × forked, with unequal lobes. Foliage fronds more or less pendulous, asymmetrical, 25–90 cm long, up to 5 × forked, ultimate segments angustate to triangular, densely hairy. Hairs with 8–12 rays to 0.3 mm long. — **Fig. 19c.**

Distribution — *Malesia*: East Java to Lesser Sunda Islands (Timor).

Habitat — Epiphytic, in primary and secondary monsoon forest. Altitude from sea level up to 2000 m.

Notes — 1. A polymorphic species. The infraspecific taxa have often been given specific status, but they hybridise easily under cultivation, producing many different intermediate forms.

2. This is a very popular species in cultivation, with many different forms being offered commercially.

2. *Platycerium coronarium* (König ex Müller) Desv.

Platycerium coronarium (König ex Müller) Desv., Mém. Soc. Linn. Paris 6 (1827) 213; Alderw., Malayan Ferns (1908) 711; Copel., Sarawak Mus. J. 2, 3, 7 (1917) 389; Backer & Posth., Varenfl. Java (1939) 248, f. 62; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 445, f. 52: 1 (as *Platycerium grande*); Holtum, Revis. Fl. Malaya 2 (1955) 138, f. 57; Copel., Fern Fl. Philipp. 3 (1960) 458; Joe, Bailey 12 (1964) 86, f. 38a, b; De Jonch., Blumea 15 (1967) 446; Joe Hoshiz., Amer. Fern J. 60 (1970) pl. 18: 2, pl. 19: 29; Biotropica 4 (1972) 95, pl. 2: 17, pl. 4: 21, 22, pl. 6: 21, pl. 7: 17, pl. 8: 17; Yong, Natura Malaysiana 2, 4 (1977) 35; Hennipman & Roos, Monogr. *Platycerium* (1982) 92, f. 20e–h, 21; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 30. — *Osmunda coronaria* König ex Müller, Naturf. 21 (1785) 197, pl. 3. — *Alcicornium coronarium* Underw., Bull. Torrey Bot. Club 32 (1905) 594. — Type: Plate 3 in Müller, 1785 (the fertile frond only).

Acrostichum biforme Sw., J. Bot. (Schrader) 1800 (2) (1801) 11, nom. illeg.; Syn. Fil. (1806) 12; Willd., Sp. Pl. 5 (1810) 111; Spr., Syst. Veg. (1827) 35; Kunze, Bot. Zeitung (Berlin) 6 (1848) 102. — *Platycerium biforme* Blume, Fl. Javae (1828) 43, pl. 18, f. 1–4, nom. illeg.; Hook., Spec. Fil. 5 (1864) 285; Bedd., Ferns Brit. India (1866) 109, f. 109; Baker, Syn. Fil. (1868) 425; Bedd., Suppl. Ferns Brit. India (1892) 445, f. 273; Racib., Pterid. Buitenzorg (1898) 57; Copel., Polypod. Philipp. (1905) 138; Ridl., J. Straits Br. Roy. As. Soc. 50 (1908) 56; J. Malay Br. Roy. As. Soc. 4 (1926) 110. — Type: Plate 3 in Müller, 1785.

Platycerium platylobum Bidin & Jamal, Gard. Bull. Sing. 39 (1987) 149; Hoshiz. & Price, Amer. Fern J. 80 (1990) 66. — Type: *Bidin & Jaman PL 149* (K; iso BM, U), Langkawi.

Rhizome scales basifixed, 15–35 by 4–10 mm, index 2 (3–5), widest near the middle, margin with a 1.5–3.5 mm wide flabelloid zone and short hairs, apex rounded, midrib present. *Fronds*: base fronds sessile, green, recurving when old, 50–110 by 25–55 cm, upper part erect, 2–5 × forked unequally, basal fringe conspicuous, veins immersed. Foliage fronds maturing subsequently, asymmetrical, 50–125(–200) cm long or longer, 3–7 × forked with 4 main lobes, lateral lobes spreading, sterile, 2–4 × forked, central sterile lobe elongated, pendulous, 3–6 × forked, central fertile lobe simple, semicircular to reniform, horizontal, 7–36 by 5–20 cm, stalk 2–9 cm long. Hairs with 7–8 rays to 0.5 mm long. *Soral patch* completely covering the fertile lobe, sporangia with 9 or 10 indurated annulus cells, interspersed with long-stalked receptacular paraphyses with apical clusters of 12–20 short, clavate rays. Spores 8 per sporangium. — **Fig. 19d.**

Distribution — Indochina to W Malesia. In *Malesia*: Sumatra, Peninsular Malaysia, Java, Borneo, Philippines.

Habitat — Epiphytic, growing in clusters in everwet primary and secondary forest, also in plantations and otherwise disturbed places, on shaded low as well as high, exposed branches. Altitude from sea level to 500(–1000) m.

Uses — Ashes are rubbed over the body to cure spleen disease (*Burkill & Haniff SF 13618*).

Notes — 1. One of the most striking epiphytes of the area, also very common in gardens.

2. All sporangia, together with the paraphyses, dehisce simultaneously, and are shed in thick tufts of golden-brown fluff.

3. Sometimes noted as inhabited by termites.

3. *Platycterium grande* (Fée) Kunze

Platycterium grande (Fée) Kunze, *Linnaea* 23 (1850) 474, p.p.; [J. Sm., *J. Bot. (Hook.)* 3 (1841) 402, nom. nud.]; C. Presl, *Epim. Bot.* (1851) 154; Hook., *Gard. Chron.* (1858) 764; *Spec. Fil.* 5 (1864) 284; J. Sm., *Ferns Brit. & For.* (1866) 121; Baker, *Syn. Fil.* (1868) 425; Benth., *Fl. Austral.* 7 (1878) 781; F.M. Bailey, *Fernw. Austral.* (1881) 74; *Syn. Queensl. Fl.* (1883) 724; Bedd., *Suppl. Ferns Brit. India* (1892) 445; Racib., *Pterid. Buitenzorg* (1898) 57; F.M. Bailey, *Queensl. Fl.* 6 (1892) 1995; Copel., *Polypod. Philipp.* (1905) 138; Alderw., *Malayan Ferns* (1908) 708; Copel., *Leafl. Philipp. Bot.* 3 (1910) 850; Domin, *Bibl. Bot.* 85 (1915) 198; Ridl., *J. Malay Br. Roy. As. Soc.* 4 (1926) 109; Tardieu & C. Chr. in *Fl. Indo-Chine* 7, 2 (1941) 446; Copel., *Fern Fl. Philipp.* (1960) 458; Tindale, *Contr. N.S.W. Nat. Herb. Flora Ser.* 208-211 (1961) 28; Joe, *Baileya* 12 (1964) 91; De Jonch. & Hennipman, *Brit. Fern Gaz.* 10 (1970) 113, pl. 9; Joe Hoshiz., *Amer. Fern J.* 60 (1970) pl. 18: 5, 8, pl. 19: 28; *Biotropica* 4 (1972) 95, pl. 2: 15, pl. 4: 14, pl. 6: 19, pl. 7: 15, pl. 8: 15; Hennipman et al., *Fern Gaz.* 12 (1979) 47, f. 1, 2; Hennipman & Roos, *Monogr. Platycterium* (1982) 99, f. 24, 25, pl. 7a, 8a; Zamora & Co, *Guide Philipp. Flora & Fauna II* (1986) 31, 156; Hoshiz. & Price, *Amer. Fern J.* 80 (1990) 65. — *Neuroplatyceros grandis* Fée, *Mém. Foug.* 2. *Acrost.* (1845) 103, p.p. — *Alcicornium grande* Underw., *Bull. Torrey Bot. Club* 32 (1905) 594, p.p. — *Platycterium grande* Kunze var. *normale* Domin, *Bibl. Bot.* 85 (1915) 200, p.p., nom. illeg. — Type: *Cuming 157* (BM), Philippines.

Rhizome scales basifixed, 12.5–22 by 2–4.5 mm, index 3.5–8, widest near the base, margin with hairs up to 1 mm long, apex acute, midrib absent. *Fronds*: base fronds sessile, green, recurving when old, 80–110 by 90–180 cm, lower part with sinuose margin, upper part spreading, 3–5 × forked equally, basal fringe conspicuous. Foliage fronds maturing in pairs, symmetrical, 50–120 cm long, with 2 equally long main lobes, each with a wide, horizontal soral patch and two lateral, pendulous, 3–7 × forked lobes. Hairs with 8–13 rays up to 0.25 mm long. *Soral patch* semicircular, 7–35 by 2–22 cm; sporangia with (15–)17–22(–24) indurated annulus cells. Spores 64 per sporangium. — **Fig. 19e, 20.**

Distribution — See Hoshizaki & Price (1990). In *Malesia*: Philippines (Mindanao, Ticao?). Reported to be extinct in Luzon, Mt San Cristobal by Zamora & Co, l.c.

Habitat — Epiphytic, growing solitary in crowns of trees. Altitude from sea level to 1000 m (Zamora & Co, l.c.).

4. *Platycterium holttumii* De Jonch. & Hennipman

Platycterium holttumii De Jonch. & Hennipman, *Brit. Fern Gaz.* 10 (1970) 116, pl. 12: f. 1-3; Joe Hoshiz., *Amer. Fern J.* 60 (1970) pl. 19: 26; *Biotropica* 4 (1972) 95, pl. 1: 9, pl. 2: 13, pl. 4: 15, pl. 6: 18, pl. 7: 13, pl. 8: 13; Hennipman & Roos, *Monogr. Platycterium* (1982) 101, f. 25, 26, pl. 2. — Type: *Hennipman 3968* (L; iso BKF, KYO), Thailand.

Rhizome scales basifixed, 17–28 by 2.5–4.5 mm, index 5–9, widest near the base, margin with hairs up to 1 mm long, apex acute to acuminate, midrib absent. *Fronds*:

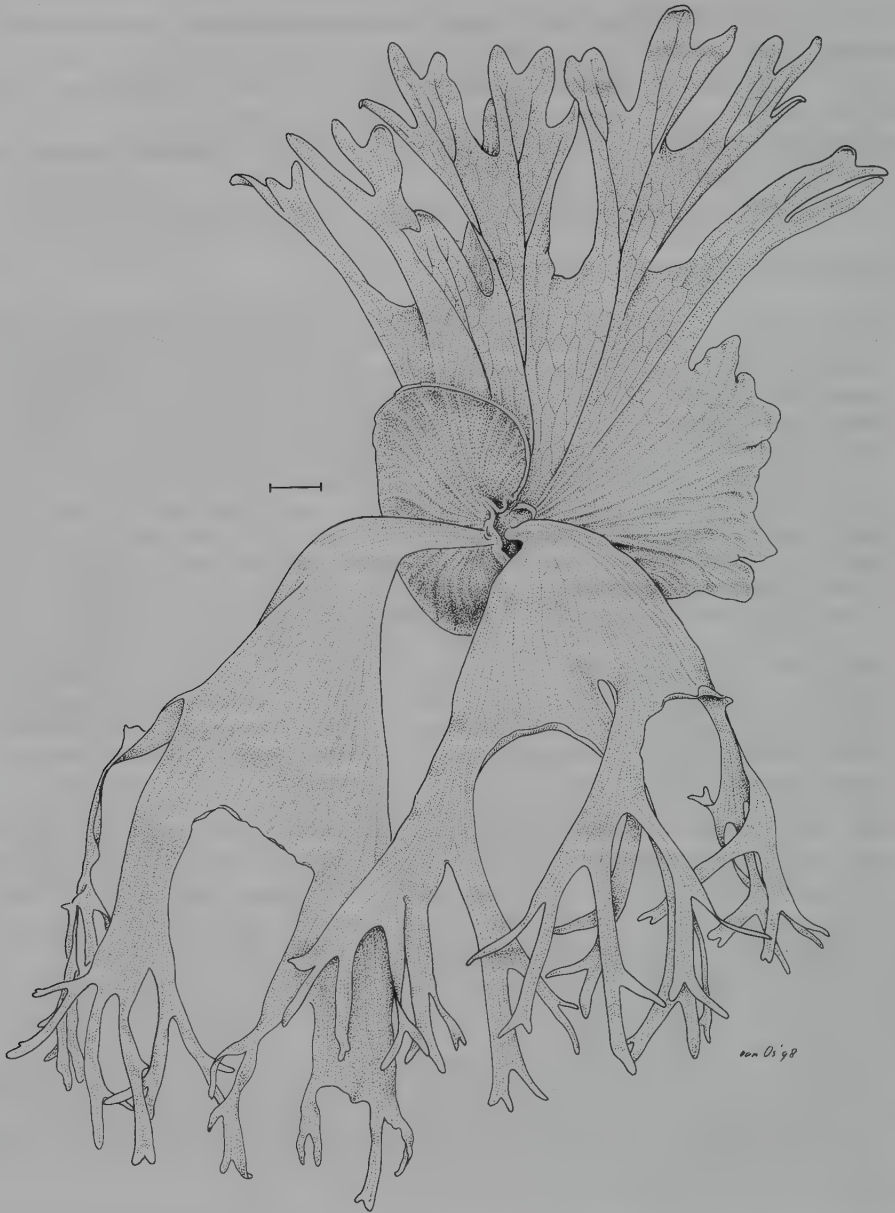


Fig. 20. *Platycerium grande* (Fée) Kunze. Habit (a cultivated specimen in Leiden Botanical Garden). Scale bar = 5 cm. Drawing by J.H. van Os.

base fronds sessile, green, recurving when old, 90–115 by 90–135 cm, lower part with sinuose margin, upper part spreading, 3–6 × forked equally, basal fringe conspicuous. Foliage fronds maturing in symmetrical pairs, asymmetrical, 95–125 cm long, with 2 unequally long main lobes, each with a wide, horizontal soral patch and

2 lateral, pendulous lobes, those of the central main lobe forked 3–5 times, of the lateral main lobe forked 2–3 times. Hairs with 9–13 rays up to 0.3 mm long. *Soral patch* semicircular, 10–45 by 8–35 cm; sporangia with (16–)18–21 indurated annulus cells. Spores 64 per sporangium. — **Fig. 19f, 21.**



Fig. 21. *Platycerium holttumii* De Jonch. & Hennipman. Habit (a cultivated specimen in Leiden Botanical Garden). Scale bar = 5 cm. Drawing by J.H. van Os.

Distribution — Indochina, S Thailand; in *Malesia*: N Peninsular Malaysia.

Habitat — Epiphytic, growing solitary, in evergreen or deciduous forest in monsoon areas. Altitude from sea level up to 700 m.

5. *Platyserium ridleyi* H. Christ

Platyserium ridleyi H. Christ, Ann. Jard. Bot. Buitenzorg Suppl. 3 (1909) 8, pl. 2; Alderw., Malayan Ferns Suppl. (1917) 422; Ridl., J. Malay Br. Roy. As. Soc. 4 (1926) 110; Holttum, Revis. Fl. Malaya 2 (1955) 140; Joe, Baileya 12 (1964) 96, f. 44; Joe Hoshiz., Amer. Fern J. 60 (1970) pl. 19: f. 30, Biotropica 4 (1972) 95, pl. 1: 8, pl. 2: 18, pl. 4: 23, pl. 6: 22, pl. 7: 18, pl. 8: 18; Hennipman & Roos, Monogr. *Platyserium* (1982) 107, f. 20 1–2, 21; Franken & Roos, Amer. Fern J. 72 (1982) 12. — *Platyserium biforme* (Sw.) Blume var. *erecta* Ridl., J. Straits Br. Roy. As. Soc. 50 (1908) 56. — Type: *Ridley SF 10830* (SING holo; P), Singapore.

Platyserium coronarium (König ex Müller) Desv. var. *cucullatum* Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 25; Malayan Ferns (1908) 711. — Type: *Teijsmann s.n.* (SING), Lingga Archipelago.

Rhizome scales basifixed, 8–15 by 4–9 mm, index 1.5–2, widest near the middle, margin with flabelloid zone up to 3.5 mm wide and short hairs, apex rounded, midrib present. *Fronds*: base fronds conspicuously stalked, green, appressed when old, 20–50 by 20–40 cm, margin entire, veins prominent. Foliage fronds maturing subsequently, asymmetrical, erect, 25–50 cm long or longer, with two unequal main lobes, one sterile, forked 4–6 times, one fertile, forked 4–7 times, with a central horizontal, stalked fertile patch. Hairs with 6–11 rays up to 1 mm long. *Soral patch* stalked 2–10 cm, obovate to elliptical, rarely bilobed or forked, 5–17 by 3–15 cm, sporangia with 10 or 11 indurated annulus cells, interspersed with receptacular paraphyses with 11–15 short-clavate rays. Spores 8 per sporangium. — **Fig. 19g.**

Distribution — Thailand. In *Malesia*: Sumatra, Peninsular Malaysia, Borneo.

Habitat — Epiphytic, growing with several specimens in one host tree, but not in clusters. In very humid forests (swamps), as high epiphyte over 25 m above ground level, exposed. Altitude from sea level to 200 m.

Notes — 1. A large number of specimens usually grows on a single host tree, often in association with *Lecanopteris* species.

2. All sporangia are shed simultaneously, together with the paraphyses, after the spores have been released.

6. *Platyserium wandae* Racib.

Platyserium wandae Racib., Bull. Int. Acad. Sc. Lett. Cracovie (1902) 58; Alderw., Malayan Ferns (1908) 709; Joe, Baileya 12 (1964) 107; De Jonch., Blumea 16 (1968) 109, f. 1, 2; Joe Hoshiz., Amer. Fern J. 60 (1970) pl. 18: 7, pl. 19: 27; Biotropica 4 (1972) 95, pl. 2: 14, pl. 4: 16, pl. 6: 17, pl. 7: 14, pl. 8: 14; Hennipman & Roos, Monogr. *Platyserium* (1982) 115, f. 25, 31. — Type: a specimen cultivated in the Botanic Gardens, Bogor (BO, n.v.); origin: *Meijwes s.n.*, 1899, NW New Guinea.

Platyserium wilhelminae-reginae Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 24, pl. 6, 7; Malayan Ferns Suppl. (1917) 421; Joe, Baileya 12 (1964) 109, f. 49. — *Alcicornium wilhelminae-reginae* Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 24, nom. illeg. — Type: *Alderwerelt s.n.*, 1908 (BO; iso L).

Rhizome scales basifixed, 14–26 by 1.5–3 mm, index 7–12, widest near the middle, margin with hairs up to 0.5 mm long, apex acute to acuminate, a narrow midrib present in the upper part. *Fronds*: base fronds sessile, green, recurving when old, 100–125 by 100–135 cm, lower part with sinuose margin, upper part spreading, 4–6 × forked equally, basal fringe conspicuous, small appendages ('aphlebia-like structures') present near the attachment. Foliage fronds maturing in symmetrical pairs, asymmetrical, 50–135 cm long, with two unequally long main lobes, each with a wide, horizontal soral patch and two lateral lobes, those of the central main lobe pendulous, forked 3–4 times, of the lateral main lobe simple, very short. Hairs with 7–13 rays up to 0.5 mm long. *Soral patch* semicircular to transverse-angustate, 7–33 by 20–60 cm; sporangia with 26–28(–30) indurated annulus cells. Spores 64 per sporangium. — **Fig. 19h.**

Distribution — *Malesia*: Moluccas, Aru Islands, New Guinea.

Habitat — Epiphytic, growing solitary, high, in dry lower montane rain forest and lowland swamp forest, also in lowland areas in rubber and coconut plantations, on wayside trees etc. Locally abundant. Altitude from sea level to 1000 m.

PODOSORUS

(H.P. Nooteboom)

Podosorus Holttum, Kew Bull. 20 (1967) 455, f. 1. — Type species: *Podosorus angustatus* Holttum.

A remarkable monotypic genus with a simple venation that could be derived from the venation of some species of *Leptochilus* and *Microsorium*.

Podosorus angustatus Holttum

Podosorus angustatus Holttum, Kew Bull. 20 (1967) 455, f. 1; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 157, f. 22; Noot., Blumea 42 (1997) 373. — Type: *PNH 78332* (Gutierrez) (K; iso L), Philippines, Luzon.

Rhizome terete, 0.8–3 mm thick, short-creeping, internodes 1–10 mm long, not white waxy, bearing scales and hairs, vascular strands without sclerified sheaths, sclerenchyma strands present. *Rhizome scales* pseudopeltate, densely set, slightly spreading, narrowly ovate or triangular, 1.5–4 by 0.2–1 mm, margin denticulate, apex acute, clathrate or subclathrate, central region bearing multiseptate hairs at least when young. *Fronds* not or slightly dimorphic, stipitate, thin-herbaceous. Stipe 0.3–2 cm long, 0.5–1 mm thick; lamina simple, narrowly elliptic to linear, 10–30 by 0.4–1.1 cm, index 10–50, base narrowly angustate, decurrent into a long wing, margin sinuate, apex slender, long-acuminate or rounded (in sterile fronds), lower surface without acicular hairs. *Venation*: veins prominent and distinct, 2–4 mm apart; connecting veins forming one row of large areoles parallel to the costa, bordered by smaller areoles; included veins few, more or less immersed and indistinct; marginal vein absent, free veinlets simple or once forked. *Sori* round, c. 1 mm diam., on slender, 3–4 mm long stalks on the lamina margin; round. Paraphyses peltate, clathrate.

Distribution — *Malesia*: Philippines (Luzon, Sierra Madre). Only one collection recorded.

Habitat — Along creek in Dipterocarp forest. Altitude 150 m.

Note — The venation is close to the venation of several *Microsorium* and few *Leptochilus* species. The paraphyses are peltate and clathrate as in *Lepisorus*.

POLYPODIOPTERIS

(G. Rödl-Linder)

Polypodiopsis (Copel.) C.F. Reed, Amer. Fern J. 38 (1948) 87; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 228; Rödl-Linder, Blumea 39 (1994) 365. — *Polypodiopsis* Copel., Gen. Fil. (1947), nom. illeg., non Carrière (1867). — Type species: *Polypodiopsis proavita* (Copel.) C.F. Reed

Medium-sized epiphytic ferns. *Rhizome* terete, creeping with internodes 0.3–2 cm long, 2–6 mm thick, glaucous, covered with scales. Anatomy: ground tissue parenchymatous, vascular strands 7–15, in a regular circle, with or without dark bundle sheaths, sclerenchyma strands many, scattered. *Rhizome scales* densely set, up to 6.5 mm long, base pseudopeltate or peltate, apex acute to filiform, brown, cells opaque or clathrate in the acumen. *Fronde*s monomorphic, stipitate, pinnatifid. Stipe adaxially grooved, glabrous or with some scales; midrib flat or grooved above, pinnae adnate, perpendicular to somewhat ascending, apical pinnae gradually reduced, terminal segment conform, adnate. Indument consisting of sparse, 2-celled glandular hairs. *Venation* with 1 or 2 series of irregular areoles, included veins absent or rarely present, excurrent, short; marginal row of free, excurrent veins present; hydathodes present, terminal on the free veins. *Sori* in one row between costa and margin, superficial or slightly sunken, c. 2 mm diam., without receptacular paraphyses. Sporangia on stalks to 0.3 mm, capsule 0.3–0.4 mm high, with 10 or 11 indurated annulus cells. Spores brown, shallowly pustulate with scattered spines. — **Fig. 22.**

Distribution — *Malesia*: Borneo.

Taxonomy — A small group, distinguished from *Polypodium* by the closed venation pattern and the spores, which have a sculpture closely resembling that of *Selliguea* and the drynarioid ferns. Its affinities are probably with *Selliguea* rather than with *Polypodium* s.s. or *Goniophlebium*, to which there is a superficial similarity.

KEY TO THE SPECIES

- 1a. Rhizome scales entire to irregularly denticulate, light reddish brown **1. *P. brachypoda***
- b. Rhizome scales dentate to ciliate, dark brown to nearly black 2
- 2a. Pinnae straight, 0.5–1.5 their width distant, margin flat, crenate, lamina to 7.5 cm wide, rhizome with 30–40 sclerenchyma strands, sori sunken . . . **2. *P. colorata***
- b. Pinnae often curved, 1–3 their width distant, margin revolute, sinuose to lobed, lamina to 20 cm wide, rhizome with over 90 sclerenchyma strands, sori superficial or slightly sunken **3. *P. proavita***

1. *Polypodiopteris brachypoda* (Copel.) C.F. Reed

Polypodiopteris brachypoda (Copel.) C.F. Reed, Amer. Fern J. 38 (1948) 87; Rödl-Linder, Blumea 39 (1994) 368. — *Polypodiopsis brachypoda* (Copel.) Copel., Gen. Fil. (1947) 210. — *Polypodium brachypodum* Copel., Philipp. J. Sc. 12 (1917) 62, 'brachypodium'; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 305; Dansk Bot. Ark. 9 (1937) 40. — Type: *Topping* 1823 (?MICH; iso GH), Borneo.

Rhizome 2.5–4 mm thick, short-creeping with internodes to 1 cm long, sclerenchyma strands 50 or more, vascular strands with or without sclerified sheath. *Rhizome scales* shining reddish brown, spreading to squarrose, peltate, 5–6.5 by 0.7–1 mm, base rounded, dentate; acumen more or less abruptly narrowed above the base, gradually narrowing towards the apex, without a thickened midrib, margin entire to irregularly denticulate. *Stipe* to 20 cm long, 0.2–0.7 × as long as lamina, lamina 36 by 9 cm, index 3–6; pinnae to 5 mm wide, 0.3–1.5 their own width distant, basal pinnae equal to medial, rarely reduced, margin crenate to serrate, revolute. *Venation* with one row of irregular areoles, included free veins absent. *Sori* superficial, at 1/3 between costa and margin. Spores 75–87 µm, pusticulate, spines blunt and/or swollen, globules few to many. — **Fig. 22c.**

Distribution — *Malesia*: Borneo (Sabah: Crocker Range).

Habitat — Epiphytic, primary or disturbed forest. Altitude 1350–2250 m.

2. *Polypodiopteris colorata* (Copel.) C.F. Reed

Polypodiopteris colorata (Copel.) C.F. Reed, Amer. Fern J. 38 (1948) 87; Rödl-Linder, Blumea 39 (1994) 369. — *Polypodium coloratum* Copel., Philipp. J. Sc., Bot. 3 (1909) 347. — *Polypodiopsis colorata* (Copel.) Copel., Gen. Fil. (1947) 210. — Type: *J. Hewitt* 35 (MICH), Borneo.

Rhizome 2–4 mm thick, long-creeping with internodes 0.5–2 cm long, sclerenchyma strands 30–40, vascular strands without sclerified sheath. *Rhizome scales* reddish brown, spreading to squarrose, pseudopeltate or peltate, 3.5–6.1 by 0.7–0.9 mm, base rounded, dentate; acumen abruptly contracted above the base, entirely consisting of a thickened midrib with narrow, elongated cells, margin dentate to ciliate, apex filiform. *Stipe* to 0.4–0.8 × as long as lamina, lamina 30 by 7.5 cm, index 2.5–3.3; basal pinnae equal to medial, 5 mm wide, 0.5–1.5 their own width distant, margin crenate to serrate, flat. *Venation* with one row of irregular areoles, included free veins absent. *Sori* slightly sunken, pusticulate on adaxial surface, at 1/4–1/3 between costa and margin. Spores 65–70 µm, pusticulate, spines present, blunt and/or swollen, globules. — **Fig. 22a–d.**

Distribution — *Malesia*: Borneo (mountain ranges).

Habitat — Epiphytic, in forest. Altitude 1000–1450 m.

3. *Polypodiopteris proavita* (Copel.) C.F. Reed

Polypodiopteris proavita (Copel.) C.F. Reed, Amer. Fern J. 38 (1948) 87; Rödl-Linder, Blumea 39 (1994) 369. — *Polypodium proavita* Copel., Philipp. J. Sc., Bot. 3 (1909) 347; C. Chr., Dansk Bot. Ark. 9 (1937) 40. — *Polypodiopsis proavita* (Copel.) Copel., Gen. Fil. (1947) 210. — Type: *Brooks & Hewitt s.n.* (MICH), Borneo.

Polypodium cesatianum [Baker, J. Bot. (Hook.) 8 (1879) 42, nom. nud.] Alderw., Malayan Ferns (1908) 603; Copel., Philipp. J. Sc., Bot. 12 (1917) 62; C. Chr., Dansk Bot. Ark. 9 (1937) 40. —

Type: *Beccari s.n.* (RO), Borneo.

Polypodium coloratum auct. non Copel.: C. Chr., Dansk Bot. Ark. 9 (1937) 40.

Polypodium papillosum auct. non Blume: Ces., Atti Accad. Sci. Fis. (1876) 25.

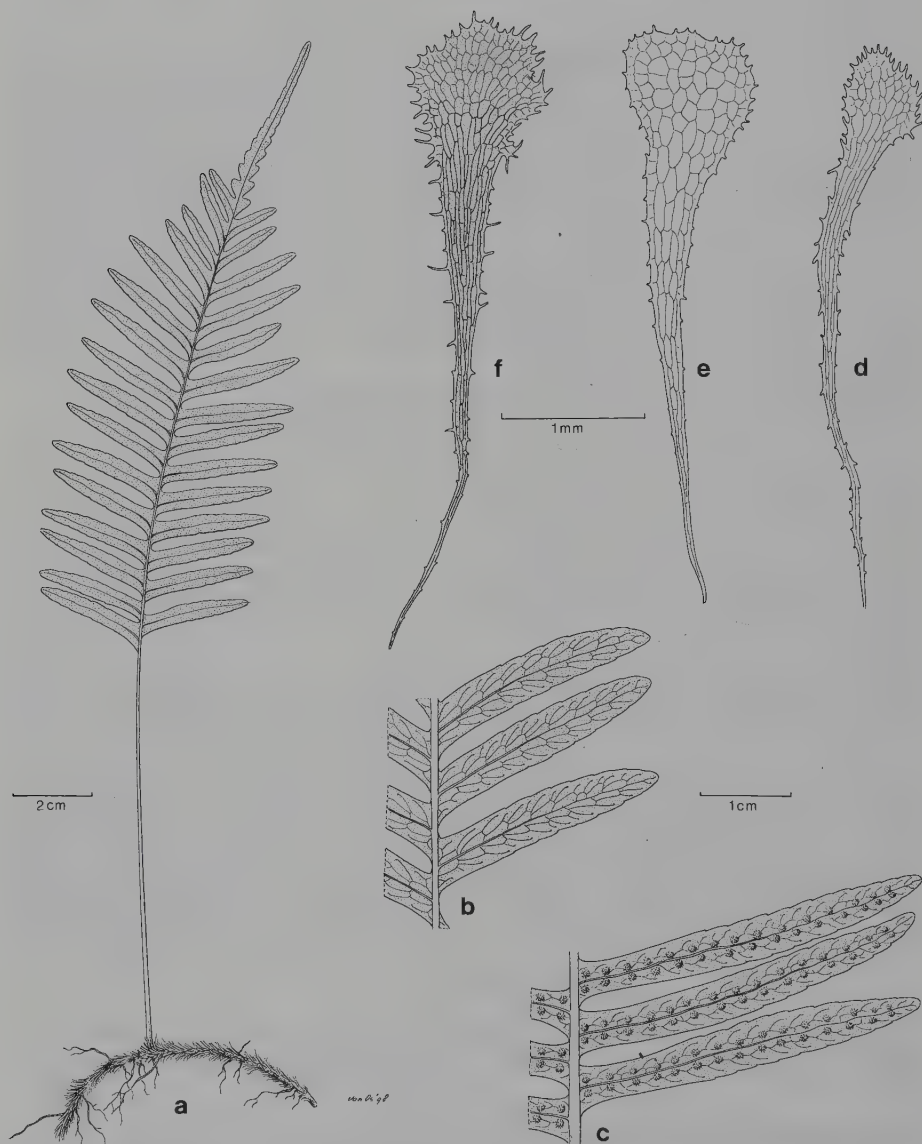


Fig. 22. *Polypodiopsis colorata* (Copel.) C.F. Reed. a. Habit; b. venation pattern; c. fertile pinnae; d. rhizome scale. — *P. brachypoda* (Copel.) C.F. Reed. e. Rhizome scale. — *P. proavita* (Copel.) C.F. Reed. f. Rhizome scale (a, b: Bell 2019; c, d: Mogeia 3987; e: Topping 1620; f: Brooks s.n., April 1909). Drawings by J.H. van Os.

Rhizome 2.6–6 mm thick, short-creeping with internodes to 1 cm long, sclerenchyma strands more than 90, vascular strands without sclerified sheath. *Rhizome scales* dark brown to black, appressed, rarely spreading, peltate, 2.9–5.7 by 0.6–1.1 mm, base rounded, dentate; acumen gradually narrowed or somewhat contracted above the base, entirely filled with narrow, elongated, thick-walled cells, margin dentate to ciliate, apex filiform. *Stipe* to 26 cm long, 0.3–0.5 × as long as lamina, lamina to 60 by 20 cm, index 3.1–4.6; pinnae 1–3 × their own width distant, very unequal in length, lower pairs reduced, 5–8 mm wide, margin serrate to lobed, revolute. *Venation* with 1 or 2 rows of irregular areoles, included free veins absent or sometimes present, minute. *Sori* superficial or slightly sunken. Spores 66–75 µm, pustulate, spines absent, globules present, few to many. — **Fig. 22f.**

Distribution — *Malesia*: Borneo (mountain ranges).

Habitat — Epiphytic on trunks or branches, in forest. Altitude 600–1050 m.

Note — Stunted forms from montane forests near 1000 m altitude may be small and resemble *P. brachypoda* in habit, but can be distinguished by the scales.

PYRROSIA

(P. H. Hovenkamp)

Pyrrosia Mirb., Hist. Nat. Gen. 4 (1803) 70; Hist. Nat. Vég. 5 (1803) 91; Farwell, Amer. Midl. Nat. 12 (1931) 245; Ching, Bull. Chin. Bot. Soc. 1 (1935) 36; Copel., Gen. Fil. (1947) 192; Holtum, Revis. Fl. Malaya 2 (1955) 141; Copel., Fern Fl. Philipp. (1960) 469; Hovenkamp, Leiden Bot. Ser. 9 (1986); Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 211. — Type species: *Pyrrosia chinensis* Mirb. (= *Pyrrosia stigmosa*).

Cyclophorus Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 300; C. Chr., Index Filic. (1906) 197; Alderw., Malayan Ferns (1908) 678; Backer & Posth., Varenfl. Java (1939) 237. — *Nipholobolus* Kaulf., Enum. (1824) 124, nom. superfl.; Blume, Enum. Pl. Javae (1828) 102; Fl. Javae Fil. (1829) 48; Giesenh., Nipholobolus (1901). — Type species: *Cyclophorus adnascens* (Sw.) Desv. (= *Pyrrosia lanceolata*).

Pteropsis Desv., Mém. Soc. Linn. Paris 6 (1827) 218; Maxon, Contr. U.S. Nat. Herb. 10 (1903) 486; Copel., Gen. Fil. (1947) 194; Fern Fl. Philipp. (1960) 475; nom. rejic. — Type species: *Acrostichum heterophyllum* L. (= *Pyrrosia heterophylla*)

Drymoglossum C. Presl, Tent. Pterid. (1836) 227; C. Chr., Index Filic. (1906) xlv, 246; Dansk Bot. Ark. 6 (1929) 83; Holtum, Revis. Fl. Malaya 2 (1955) 149; Ravensberg & Hennipman, Leiden Bot. Ser. 9 (1986) 281; nom. cons. — Type species: *Drymoglossum piloselloides* (L.) C. Presl (= *Pyrrosia piloselloides*).

Epiphytic, epilithic or terrestrial, in small tufts or extensive clones. *Rhizome* to 0.7 cm thick, short- to long-creeping appressed to or just immersed in substrate, phyllo-pods in two rows, contiguous or to 9 cm apart, sparsely to profusely branching from lateral buds. Anatomy: vascular strands 3–12, ground tissue parenchymatous with a distinct sclerenchyma sheath or totally sclerified, sclerenchyma strands absent to many. *Rhizome scales* appressed to squarrose, basifixed, (pseudo-)peltate, to 14 by 3.3 mm, not clathrate, entire, dentate or ciliate with curly cilia, hyaline to brown, central region often darker. *Fronds* mono- to dimorphic, nearly sessile to stalk-ed, simple, coriaceous, often succulent with a distinct subepidermal water-tissue. *Venation*:¹

1) This description is based on a cleared preparation; depending on the texture of the lamina, parts of it may not be visible.

veins mostly distinct, connective veins forming one to several series of rectangular areoles, veinlets simple, forked or more copiously branched and anastomosing, free veinlets excurrent, recurrent or to all directions. Upper surface with or without hydathodes. Indument composed of stellate hairs with straight and on the lower surface sometimes also with curly rays, the straight rays often forming a distinct upper layer, short (0.2 mm) and wide ('boat-shaped') to long (1 mm) and acicular. *Sori* round to elongated or forming a longitudinal coenosorus, superficial to deeply sunken, containing c. 10 to many sporangia. Paraphyses similar to the lamina-indument or differentiated. Sporangia sessile to stalked, 0.2–0.6 mm long, annulus with 9–22 indurated cells. Spores monolete, with a variously sculpted perispore. — **Fig. 23–27.**

Distribution — Paleotropic, Africa to Pacific Islands (Pitcairn). Throughout *Malesia*. Most diverse in Sumatra.

Taxonomy — *Pyrrosia* is here treated as including *Drymoglossum*, which has been kept separate by, e.g., Copeland (1947) and Holttum (1954). The Malesian species of *Pyrrosia* can be assigned to seven distinct groups (Hovenkamp 1986); the *P. costata*-group (*P. stigmosa*, *P. princeps*, *P. splendens*); the *P. porosa*-group (in Malesia only *P. porosa*); the *P. lingua*-group (*P. abbreviata*, *P. christii*, *P. sphaerosticha*); the *P. albicans*-group (*P. kinabaluensis*, *P. nummularifolia*, *P. rasamalai*, *P. albicans*, *P. asterosora*, *P. distichocarpa*); the *P. angustata*-group (*P. angustata*, *P. samarensis*, *P. novo-guineae*), the *P. lanceolata*-group (*P. lanceolata*, *P. longifolia*, *P. foveolata*, *P. fallax*), and the *P. piloselloides* group (*P. piloselloides*). *Pyrrosia penangiana* is an isolated species, without closely related species. This classification is based on shape and structure of the rhizome scales, structure of the indument, shape and structure of the lamina, shape and structure of the sori, and spore sculpture. Other classifications, based mainly on a single character complex (e.g., the traditional recognition of *Drymoglossum* based on frond dimorphy, or the elaborate classification by Shing based on details of indument) are not satisfactory.

Pyrrosia is a distinct genus. The 'drymoglossoid' species (those with highly dimorphic fronds and coenosori) have been separated as *Drymoglossum*, otherwise it has been used in the current circumscription by most 20th century authors. Uniting characters are primarily the peculiar stellate hairs, but the sclerenchyma sheath in the rhizome and absence of pinnate divisions of the fronds also contribute to the distinctness of the genus. Its closest relative is *Platynerium*, which shares these characters.

KEY TO THE SPECIES

- 1a Rhizome completely sclerified, scales basifixed, spores smooth 2
- b Rhizome with parenchymatous ground tissue, scales pseudopeltate or peltate, spores variously ornamented 5
- 2a. Fronds distinctly stalked, sori spread all over the lamina **23. *P. stigmosa***
- b. Fronds sessile or indistinctly stalked, sori in an apical patch 3
- 3a. Phyllopods 1–2 cm apart. — Borneo **16. *P. platyphylla***
- b. Phyllopods contiguous 4
- 4a. Hairs with all rays appressed or approximately equally spreading **18. *P. princeps***
- b. Hairs with appressed rays and one elongated, erect spine. — Philippines **22. *P. splendens***

- 5a. Sporangia in a longitudinal coenosorus 6
 b. Sporangia in round or elongate, separate sori (fertile fronds absent follow this lead) 9
- 6a. Rhizome scales ciliate 7
 b. Rhizome scales entire 8
- 7a. Rhizome scales elongate, over 5 times as long as wide, coenosorus sunken, paraphyses many, in a medial row in the coenosorus **7. *P. fallax***
 b. Rhizome scales short, less than 3 times as long as wide, coenosorus superficial, paraphyses inconspicuous **15. *P. piloselloides***
- 8a. Stellate hairs dimorphic, sterile fronds mostly not wider than the basal part of the fertile ones **20. *P. samarensis***
 b. Stellate hairs monomorphic, appressed, sterile fronds much wider than the fertile ones **12. *P. novo-guineae***
- 9a. Sori clearly in a single row between costa and margin 10
 b. Sori in at least two rows between costa and margin (in doubt or fertile fronds absent follow this lead) 12
- 10a. Small plants, fertile fronds to 0.5 cm wide, indument monomorphic, appressed **8b. *P. foveolata* var. *lauterbachii***
 b. Medium to large plants, fertile fronds 1 cm wide or more, indument dimorphic, loose 11
- 11a. Scales brown (an aberrant form from Flores; compare also narrow forms of 19. *P. rasamalai* or 13. *P. nummularifolia*) **2. *P. albicans***
 b. Scales with hyaline acumen **3. *P. angustata***
- 12a. Sori sunken 13
 b. Sori superficial (or fertile fronds absent) 15
- 13a. Paraphyses mixed with the sporangia **8. *P. foveolata***
 b. Paraphyses in a central group in the sorus 14
- 14a. Rhizome flexible, scales ciliate **10. *P. lanceolata***
 b. Rhizome rigid, scales entire **11. *P. longifolia***
- 15a. Hydathodes absent 16
 b. Hydathodes present 26
- 16a. Stellate hairs dimorphic, not appressed 19
 b. Stellate hairs monomorphic, appressed 17
- 17a. Lateral buds close to the phyllopods on the other side of the rhizome **8. *P. foveolata***
 b. Lateral buds halfway between the phyllopods 18
- 18a. Rhizome without central sclerenchyma **15. *P. piloselloides***
 b. Rhizome with a central sclerenchyma sheath (these two species are difficult to distinguish when sterile) **10. *P. lanceolata* or 7. *P. fallax***
- 19a. Stellate hairs appressed, with boat-shaped straight rays .. **9. *P. kinabaluensis***
 b. Stellate hairs with acicular straight rays, not appressed 20
- 20a. Rhizome scales dentate or ciliate 23
 b. Rhizome scales entire 21
- 21a. Scales with hyaline acumen, often squarrosely recurved (these two species are difficult to distinguish when sterile) ... **3. *P. angustata* or 20. *P. samarensis***
 b. Scales brown, spreading but not recurved 22

- 22a. Lamina 1.5–4 cm wide, rhizome scales 1.5–2.5 mm wide, usually widest above the attachment, sori to 2.5 mm, with many conspicuous paraphyses **2. *P. albicans***
- b. Lamina up to 1 cm wide, rhizome scales 0.4–1.4 mm wide, widest near the attachment, sori 1–1.5 mm, without conspicuous paraphyses **19. *P. rasamalae***
- 23a. Rhizome scales ciliate 24
- b. Rhizome scales dentate 25
- 24a. Sterile fronds elongate, index 3–8, apex acute, fertile fronds not much narrowed **9. *P. kinabaluensis***
- b. Sterile fronds ovate to rounded, index 1–2, apex rounded, fertile fronds conspicuously narrowed **13. *P. nummularifolia***
- 25a. Rhizome scales not squarrose, widest above the attachment, lamina to 62 (97) by 5.5 cm **6. *P. distichocarpa***
- b. Rhizome scales with long, sheathing base and squarrose acumen, widest near the attachment, lamina to 35 by 3 cm **4. *P. asterosora***
- 26a. Sori deeply sunken, rhizome elongated with lateral buds close to but opposite the phyllopods **8. *P. foveolata***
- b. Sori superficial, rhizome short or elongated with lateral buds not close to the phyllopods 27
- 27a. Fronds distinctly long-stalked, the sterile fronds mostly ovate to elliptical, index 1–4 28
- b. Fronds not stalked, or indistinctly stalked below a very gradually decurrent lamina, sterile fronds oblanceolate, index 6–20, or absent 30
- 28a. Rhizome scales dentate, stellate hairs sparse, thin, fugacious ... **5. *P. christii***
- b. Rhizome scales ciliate, stellate hairs forming a dense, persistent mat 29
- 29a. Rhizome scales with appressed, straight, ciliate apex **1. *P. abbreviata***
- b. Rhizome scales with spreading, entire, crisped apex **21. *P. sphaerosticha***
- 30a. Rhizome short, phyllopods contiguous, rhizome scales pseudopeltate, stellate hairs monomorphic **14. *P. penangiana***
- b. Rhizome shortly elongated, phyllopods to 0.5 cm apart, rhizome scales peltate, stellate hairs dimorphic **17. *P. porosa***

1. *Pyrrosia abbreviata* (Zoll. & Moritzi) Tagawa

Pyrrosia abbreviata (Zoll. & Moritzi) Tagawa, Acta Phytotax. Geobot. 25 (1973) 180; Hovenkamp, Leiden Bot. Ser. 9 (1986) 149. — *Niphobolus abbreviatus* Zoll. & Moritzi, Nat. & Gen. Arch. 1 (1844) 397; Giesenh., *Niphobolus* (1901) 160. — *Polypodium abbreviatum* Mett., Fil. Hort. Bot. Lips. (1856) 33; Farngatt. I. *Polypodium* (1856) 131; Racib., Pterid. Buitenzorg (1898) 98. — *Cyclophorus abbreviatus* C. Chr., Index Filic. (1906) 197; Alderw., Malayan Ferns (1908) 692; Backer & Posth., Varenfl. Java (1939) 241. — Type: Zollinger 1984 (B, P, Z), Java.

Rhizome c. 3 mm thick, long-creeping, phyllopods 4–8 cm apart, buds halfway along the internodes. Anatomy: vascular strands 9–12, sclerenchyma sheath distinct, sclerenchyma strands 15–20, in a ring within the vascular cylinder. *Rhizome scales* appressed, peltate, 3–7 by 1–1.5 mm, base entire, acumen long-ciliate, central region brown to blackish. *Fronds* dimorphic, stalked. Fertile fronds with stalks to 26 cm long, 1–2.5 × as long as the lamina, lamina 5–10 by (1–)3–5 cm, index 2–3(–7), base

narrowed, widest at or below the middle, apex rounded to acuminate. Sterile fronds with stalks (2–)5–17(–30) cm, lamina index 1.5–2(–3), otherwise similar to fertile fronds. *Venation*: veins distinct, veinlets much branched and anastomosing, free veinlets excurrent and recurrent. Hydathodes distinct. Stellate hairs monomorphic, appressed, forming a dense mat, dirty whitish, rays short, boat-shaped. *Sori* small, closely packed, superficial, developing more or less simultaneously. Sporangia stalked, paraphyses not differentiated. Spores coarsely tuberculate.

Distribution — *Malesia*: Sumatra, Java, Lesser Sunda Islands.

Habitat — Epiphytic or epilithic, usually in more or less disturbed or open sites (lakesides, cliffs, solitary trees). Altitude 350–1500 m.

Note — The scales around the phyllopods are often enlarged, forming a distinct tuft. Narrow forms occur which can be distinguished from *P. sphaerosticha* by the rhizome scales.

2. *Pyrrosia albicans* (Blume) Ching

Pyrrosia albicans (Blume) Ching, Bull. Chin. Bot. Soc. 1 (1935) 72; Hovenkamp, Leiden Bot. Ser. 9 (1986) 153. — *Nipholobolus albicans* Blume, Enum. Pl. Javae (1828) 107; Fl. Javae Fil. (1829) 60, pl. 25; Giesenh., Nipholobolus (1901) 185. — *Cyclophorus albicans* C. Presl, Epim. Bot. (1851) 131; Alderw., Malayan Ferns (1908) 688; Backer & Posth., Varenfl. Java (1939) 242. — *Polypodium albicans* Mett., Farngatt. I. Polypodium (1856) 127; Baker, Syn. Fil. (1867) 352; Racib., Pterid. Buitenzorg (1898) 101. — Type: *Reinwardt s.n.* (L), Java.

Nipholobolus flocciger Blume, Enum. Pl. Javae (1828) 61, Fl. Javae Fil. (1829) 61, pl. 26. — Type: *Blume s.n.*, s.d. (L), ?Java.

Nipholobolus flocciger var. *loriformis* Kunze, Bot. Zeitung (Berlin) (1848) 120; Giesenh., Nipholobolus (1901) 189. — *Polypodium floccigerum* var. *loriforme* Mett., Farngatt. I. Polypodium (1856) 129. — Type: *Zollinger 2022* (BO, L), Java.

Nipholobolus blumeanus Kunze, Bot. Zeitung (Berlin) 6 (1848) 120. — *Cyclophorus blumeanus* C. Presl, Epim. Bot. (1851) 130. — Type: *Zollinger 2387* (BM, L, P), Java.

Cyclophorus lancifolius Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 8; Malayan Ferns Suppl. (1917) 414. — Type: *Ajoeb 329* (BO), Sumatra.

Cyclophorus nigropunctatus Rosenst., Meded. Rijks Herb. 31 (1917). — Type: *Korthals s.n.* (L), Sumatra.

Cyclophorus elaphoglossoides Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 139. — Isotypes: *Bünnemeijer 4825, 4970* (BO), Sumatra.

Rhizome 3–4 mm thick, long-creeping, phyllopods 3–9 cm apart, buds halfway along the internodes. Anatomy: vascular strands 9–12, sclerenchyma sheath distinct, sclerenchyma strands up to 20 or more, scattered within the vascular cylinder. *Rhizome scales* spreading, peltate, 8–14 by 1.5–2.5 mm, entire, shining brown. *Fronds* monomorphic, stalks to 2–27 cm long, up to 0.2–0.5 × as long as the lamina, lamina 22–65 by 1.5–4(–5.7), index 10–12, linear, base narrowed, apex obtuse to acute. *Venation*: veins distinct, veinlets not anastomosing, free veinlets simple or forked, excurrent. Hydathodes absent. Stellate hairs dimorphic, forming a dense mat, whitish to brown, the straight upper rays acicular. *Sori* apical, to 2.5 mm wide, 3 or 4 in a single row in each areole, superficial, developing in acropetal sequence. Sporangia long-stalked, paraphyses with long, curly rays. Spores with irregular ridges and protuberances.

Distribution — *Malesia*: Sumatra, Java, Lesser Sunda Islands.

Habitat — Epiphytic, sometimes as high epiphyte, mostly in forest, but also on wayside trees, abandoned plantations etc., occasionally epilithic or terrestrial. Altitude 900–1800 m.

Note — A form occurring on Flores has narrower fronds than the typical form, in the most extreme case with only a single row of large sori between costa and margin.

3. *Pyrrosia angustata* (Sw.) Ching

Pyrrosia angustata (Sw.) Ching, Bull. Chin. Bot. Soc. 1 (1935) 49; Holttum, Revis. Fl. Malaya 2 (1955) 143, f. 58; Copel., Fern Fl. Philipp. (1960) 470; Hoshiz., Bailey 21 (1981) 57, f. 1; Hovenkamp, Leiden Bot. Ser. 9 (1986) 156. — *Polypodium angustatum* Sw., Syn. Fil. (1806) 27, 224; [non Blume, Fl. Javae Fil. (1829) 148, pl. 162]; Baker, Syn. Fil. (1867) 356; Racib., Pterid. Buitenzorg (1898) 100. — *Cyclophorus angustatus* Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 300, nom. inval.; Alderw., Malayan Ferns Suppl. (1917) 413; Copel., Sarawak Mus. J. 2 (1917) 410; Holttum, J. Malay Br. As. Soc. 6 (1928) 20. — *Niphobolus angustatus* Spr., Syst. 4 (1827) 44; Giesenh., Niphobolus (1901) 193; Copel., Sarawak Mus. J. 2 (1917) 410. — *Drynaria angustata* Fée, Gen. Filic. (1850–1852) 270. — *Niphopsis angustatus* J. Sm., Cat. Cult. Ferns (1857) 6; Hist. Fil. (1875) 105. — *Pleopeltis angustata* C. Presl, Tent. Pterid. (1836) 193; Epim. Oct. (1851) 126. — *Polypodium coriaceum* Roxb., Calc. J. Nat. Hist. 15 (1844) 481, pl. 28, nom. superfl.; Morton, Contr. U.S. Nat. Herb. 38 (1967) 339. — Type: *Rottler s.n.*, s.d. (holo S, n.v.), ?India, Trankebar.

Niphobolus sphaerocephalus Hook. & Grev., Ic. Fil. (1828) pl. 94. — *Polypodium sphaerocephalum* Wall., Cat. (1829) n. 272; Mett., Farngatt. I. Polypodium (1856) 122, pl. 3. — *Phymatodes sphaerocephala* C. Presl, Tent. Pter. (1836) 196. — Type: Wallich 272 (BM, BR, E, K, L), India. *Cyclophorus micraster* Copel., Univ. Calif. Publ. Bot. 12 (1931) 405. — *Pyrrosia micraster* Tagawa, J. Jap. Bot. 22 (1949) 163. — Type: *Md. Nur 12060* (K, SING), Malaya.

Rhizome c. 1.5–2.6 mm thick, long-creeping, phyllopoas 2–7 cm apart, buds half-way along the internodes. Anatomy: vascular strands 5–11, sclerenchyma sheath distinct, sclerenchyma strands c. 15, in a ring within the vascular cylinder, often confluent. *Rhizome scales* spreading to recurved, peltate, 5–11 by 0.5–1 mm, base entire, acumen entire to dentate, hyaline. *Fronds* dimorphic, stalked. Fertile fronds with stalks 0.5–15(–25) cm long, to 0.5(–0.75) × as long as the lamina, lamina 8–44 by 1–3.5 cm, index 5–20 or more, base narrowed, widest below middle, apex acute to acuminate. Sterile fronds with stalks 2–9 cm, lamina 5–22 by 1.5–4.5 cm, index 2–7, widest near the middle, otherwise similar to the fertile fronds. *Venation*: veins distinct, veinlets branched and often anastomosing, free veinlets mostly excurrent. Hydathodes absent. Stellate hairs dimorphic, forming a thin to thick mat, often fugaceous, light whitish brown, the straight upper rays boat-shaped to acicular. *Sori* apical to all over the lamina, 3–4 mm wide, often elongate, slightly sunken, developing acropetally. Sporangia long-stalked, paraphyses with short, straight rays. Spores with longitudinal ridges.

Distribution — *Malesia*: Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo. Rare in the Moluccas, doubtful records from Java and New Guinea.

Habitat — Epiphytic in various situations, in forest or open places, also epilithic or terrestrial, on sand. Altitude from sea level to 900 m.

Notes — 1. Older specimens may completely lose all indument, as well as the characteristically recurved acumens of the rhizome scales, and are then sometimes confused with *P. serpens* (an exclusively Pacific species).

2. Rarely, specimens occur with more than one row of sori between midrib and margin.

4. *Pyrrosia asterosora* (Baker) Hovenkamp

Pyrrosia asterosora (Baker) Hovenkamp, Blumea 30 (1984) 208; Leiden Bot. Ser. 9 (1986) 160. — *Polypodium asterosorum* Baker, J. Bot. (London) 18 (1880) 214; Ann. Bot. (London) 5 (1891) 473. — *Cyclophorus asterosorus* C. Chr., Index Filic. (1906) 198; Alderw., Malayan Ferns (1908) 694; Malayan Ferns Suppl. (1917) 413. — Type: *Beccari 458* (BM, BO, K), Sumatra.

Cyclophorus asterosorus forma *subfurfuracea* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 145. — Type: *Bünnemeijer 5153* (BO, L), Sumatra.

Rhizome 2–2.8 mm thick, long-creeping, phyllopods 2–9 cm apart, buds in the basal halves of the internodes. Anatomy: vascular strands 6–9, sclerenchyma sheath distinct, sclerenchyma strands c. 5, scattered. *Rhizome scales* squarrosely spreading, peltate, 10.5–13.3 by 1–1.3 mm, base entire, acumen dentate, shining brown. *Fronds* monomorphic, stalks 2–26 cm long, 0.2–0.5 × as long as the lamina, lamina 8–35 by 1.2–3 cm, index 6–12 or more, base gradually narrowed, widest near the middle, apex obtuse to acuminate. *Venation*: veins distinct, veinlets simple, free, excurrent. Hydathodes absent. Stellate hairs dimorphic, a dense mat, brown, the straight upper rays acicular. *Sori* apical to all over the lamina, 1.5–2.5 mm wide, 2 (rarely 3) in each areole, superficial, developing acropetally. Sporangia stalked, paraphyses with curly rays. Spores with irregular ridges. — **Fig. 23.**

Distribution — *Malesia*: Sumatra.

Habitat — Epiphytic in montane forest, restricted to the middle elevations of high mountains. Altitude 1350–2100 m.

Note — The scales with a sheathing base and squarrose acumen are highly characteristic, as are also the distinct rows of sori.

5. *Pyrrosia christii* (Giesenh.) Ching

Pyrrosia christii (Giesenh.) Ching, Bull. Chin. Bot. Soc. 1 (1935) 58; Hovenkamp, Leiden Bot. Ser. 9 (1986) 164. — *Niphobolus christii* Giesenh., Niphobolus (1901) 140, 158. — *Cyclophorus christii* C. Chr., Index Filic. (1906) 198; Alderw., Malayan Ferns (1908) 963; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 313. — Type: *Bishop of Singapore & Sarawak s.n.*, 1894 (P), Borneo.

Rhizome 1.3–3 mm thick, long-creeping, phyllopods 2–9 cm apart, buds halfway along the internodes. Anatomy: vascular strands 6–8, sclerenchyma sheath distinct, sclerenchyma strands absent. *Rhizome scales* spreading, peltate, 3.1–7.5 by 0.4–0.7 mm, base entire to dentate, acumen ciliate, light brown. *Fronds* dimorphic, stalked. Fertile fronds with stalks to 2–18 cm long, 0.2–1 × as long as the lamina, lamina 5.5–22 by 1.5–5.5 cm, index 3–10, base cuneate, widest at or below the middle, apex obtuse to acuminate. Sterile fronds with stalks 1–11 cm, 0.1–0.5 × as long as the lamina, lamina to 9 cm wide, index 2–3, otherwise similar. *Venation*: veins distinct, veinlets simple or forked, frequently anastomosing, free veinlets excurrent and recurrent. Hydathodes distinct. Stellate hairs dimorphic, appressed, forming a very thin inconspicuous mat, often fugaceous, hyaline, the straight rays short, boat-shaped.

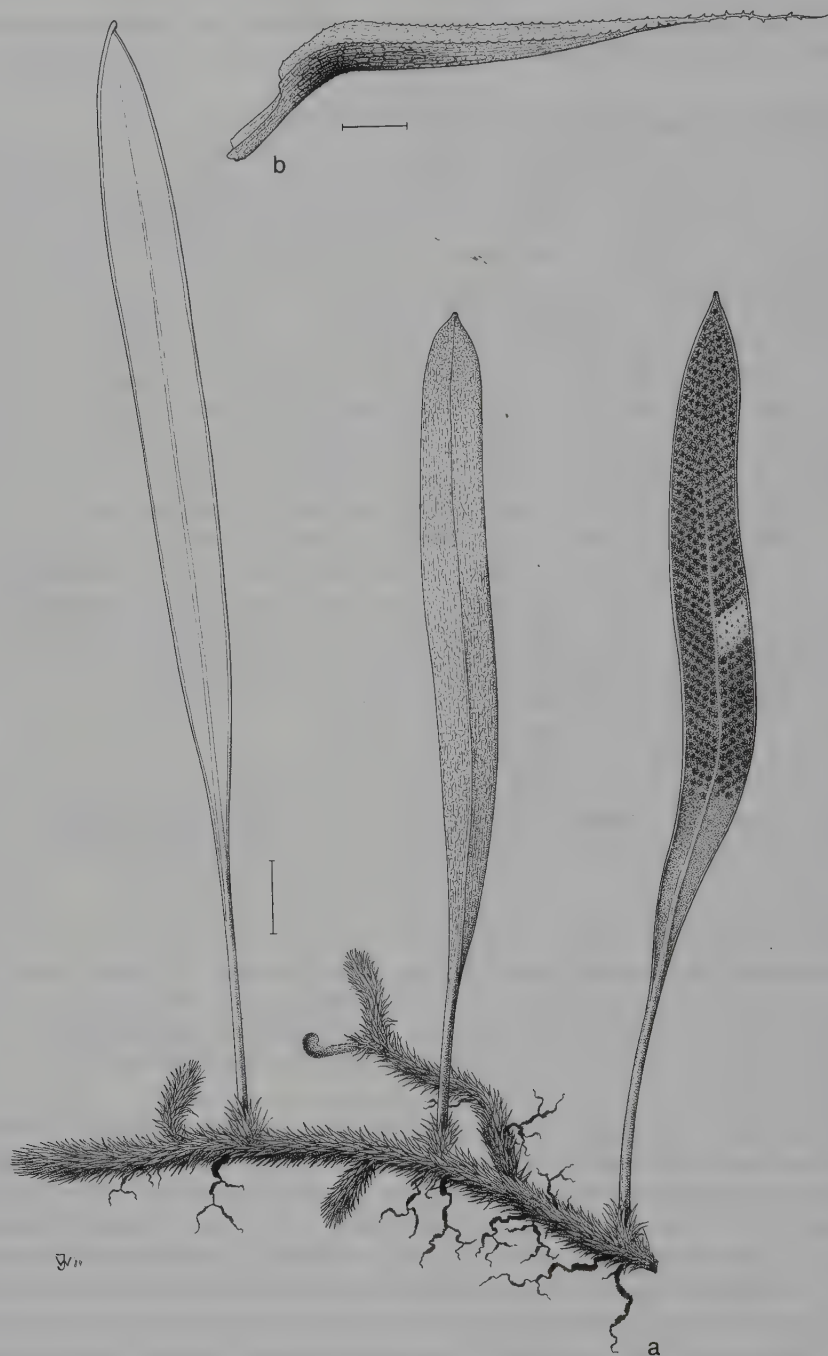


Fig. 23. *Pyrrosia asterosora* (Baker) Hovenkamp. a. Habit; b rhizome scale (a: Schiffner P 185; b: Bünnemeijer 9426). Scale bars: a = 2 cm, b = 1 mm. Drawings by J. Wessendorp. Reproduced from Hovenkamp (1986).



Fig. 24. *Pyrrosia christii* (Giesenh.) Ching. a. Habit; b. rhizome scale (a: Endert 4666; b: Endert 3146). Scale bars: a = 2 cm, b = 1 mm. Drawings J. Wessendorp. Reproduced from Hovenkamp (1986).



Fig. 25. *Pyrrosia distichocarpa* (Mett.) Shing. a. Habit; b. rhizome scale (a: Bartlett 6576; b: Bünnemeijer 4535). Scale bars: a = 2 cm, b = 1 mm. Drawings J. Wessendorp. Reproduced from Hovenkamp 1986.

Sori very closely packed, superficial, developing more or less simultaneously, soral area appearing acrostichoid when old. Sporangia stalked, paraphyses not differentiated. Spores coarsely and irregularly tuberculate. — **Fig. 24.**

Distribution — Borneo.

Habitat — Mainly epiphytic but also epilithic, sheltered or exposed. Altitude: 300–1150 m.

Note — The thin indument is often overlooked and especially older fronds may appear quite glabrous.

6. *Pyrrosia distichocarpa* (Mett.) Shing

Pyrrosia distichocarpa (Mett.) Shing, Amer. Fern J. 73 (1983) 76; Hovenkamp, Leiden Bot. Ser. 9 (1986) 173. — *Polypodium distichocarpum* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 231; Baker, Syn. Fil. (1867) 352. — *Niphobolus distichocarpus* Giesenh. ex Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 325. — *Cyclophorus distichocarpus* C. Chr., Index Filic. (1906) 198; Alderw., Malayan Ferns (1908) 963; Malayan Ferns Suppl. (1917) 413; Backer & Posth., Varenfl. Java (1939) 242. — Type: *Korthals s.n.* (B, BO, L?), Sumatra.

Cyclophorus winkleri Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 7 (1909); Alderw., Malayan Ferns Suppl. (1917) 413. — *Pyrrosia winkleri* Tagawa, Acta Phytotax. Geobot. 25 (1973) 180. — Type: *J. Winkler (Rosenstock Fil. Sum. Exsicc. 66)* (B, BM, K, L, M, P, US), Sumatra.

Cyclophorus grandis Ridl., J. Malay Br. Roy. As. Soc. 1 (1923) 112. — Type: *Ridley s.n.*, Febr. 1921 (K), Sumatra.

Rhizome (1.2–)2.7–5 mm thick, long-creeping, phyllopois 3–7 cm apart, buds about halfway along the internodes. Anatomy: vascular strands (5–)8–15, sclerenchyma sheath distinct, sclerenchyma strands absent to many, scattered within the vascular cylinder. *Rhizome scales* spreading, peltate, 8–14 by 1.1–3 mm, base entire, acumen dentate, shining brown. *Fronds* monomorphic, stalks up to 2 cm long, much shorter than the lamina, lamina 22–62(–97) by 2.5–5.5 cm, index 5–20 or more, base gradually narrowed or truncate, widest below the middle, apex obtuse to (mostly) acute. *Venation*: veins distinct, veinlets much branched and anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Stellate hairs mono- to dimorphic, a dense mat, brown to greyish brown, the straight rays acicular. *Sori* apical, spaced, 1.5–3 mm wide, 2 (rarely 3) in each areole, superficial, developing acropetally. Sporangia stalked, paraphyses with curly rays. Spores with irregular ridges and protuberances. — **Fig. 25.**

Distribution — *Malesia*: Sumatra.

Habitat — Mostly epiphytic, in various situations, primary forest, orchards, way-side trees, hedgerows etc., occasionally epilithic. Altitude 750–1900 m.

Note — Easily recognised by the large size, the conspicuous rhizome scales, and the sori mostly in distinctly paired rows.

7. *Pyrrosia fallax* (Alderw.) M.G. Price

Pyrrosia fallax (Alderw.) M.G. Price, Kalikasan 3 (1974) 177; Ravensberg & Hennipman, Leiden Bot. Ser. 9 (1986) 298. — *Drymoglossum fallax* Alderw., Philipp. J. Sc., Bot. 11 (1916) 111, f. 6; Malayan Ferns Suppl. (1917) 419; C. Chr., Dansk Bot. Ark. 6 (1929) 85, pl. 12 f. 7, pl. 13 f. 5. — Type: *Robinson 1952* (BO), New Guinea.



Fig. 26. *Pyrrosia foveolata* (Alston) Morton var. *lauterbachii* (H. Christ) Hovenkamp. a. Sterile fronds; b. fertile fronds with galled receptacle (*). — *P. foveolata* var. *foveolata*. c. Habit; d. rhizome scale (a, b: Pulle 128; c: Brass 31095; d: Veldkamp & Stevens 5509). Scale bars: a & b, c = 1 cm, d = 1 mm. Drawings J. Wessendorp. Reproduced from Hovenkamp 1986.

Rhizome c. 1 mm thick, long-creeping, phyllopods 1–1.5 cm apart, buds about halfway along the internodes. Anatomy: vascular strands 5, sclerenchyma sheath distinct, sclerenchyma strand 1, central. *Rhizome scales* spreading, peltate, up to 2.5 by 0.4 mm, base ciliate, acumen narrowing to a filiform, entire apex, central region brown. *Fronds* strongly dimorphic, stalked. Fertile fronds with stalks 1–1.5 cm long, lamina 2–8.5 by 0.2–0.4 cm, index 7–25, linear. Sterile fronds with stalks up to 0.4 cm, lamina 1–4 by 0.5–1.5 cm, index 1–5, widest at the middle. *Venation*: veins not distinct in the mesh of anastomosing veinlets, free veinlets simple or forked, excurrent. Hydathodes absent. Stellate hairs monomorphic, appressed, forming a sparse mat, hyaline, the rays short. Coenosorus apical or extending to the base of the lamina, sunken, with sporangia in two rows separated by a row of paraphyses, maturing from inside outwards. Sporangia long-stalked, paraphyses with straight rays. Spores variously tuberculate.

Distribution — *Malesia*: Moluccas, New Guinea, to Solomon Islands.

Habitat — Epiphytic on branches and trunks, in primary or secondary forest, often along rivers or forest margins. Altitude from sea level to 400 m.

8. *Pyrrosia foveolata* (Alston) Morton

Pyrrosia foveolata (Alston) Morton, Contr. U.S. Nat. Herb. 38 (1973) 234; Hovenkamp, Leiden Bot. Ser. 9 (1986) 181. — *Cyclophorus foveolatus* Alston, J. Bot. London 78 (1940) 226; Nova Guinea n.s. 4 (1940) pl. 4, f. 4. — Type: *Carr 13039* (BM, K, L, SING), New Guinea. *Cyclophorus brassii* Copel., Univ. Calif. Publ. Bot. 18 (1948) 226. — *Pyrrosia brassii* Pichi Serm., Webbia 31 (1977) 249. — Type: *Brass 11372* (A, BM, L), New Guinea.

a. var. *foveolata*

Rhizome 1–2.6 mm thick, long-creeping, phyllopods 1–3 cm apart, buds about opposite the phyllopods. Anatomy: vascular strands 5–7(–10), sclerenchyma sheath distinct, a single central sclerenchyma strand usually present, sometimes absent. *Rhizome scales* spreading, peltate, 4.2–8.8 by 0.5–1.4 mm, base entire, acumen entire or dentate to ciliate, hyaline to light brown; short, round or ovate scales without elongated acumen sometimes present. *Fronds* slightly dimorphic, indistinctly to distinctly stalked. Fertile fronds with stalks to 1–11 cm, 0.1–0.5 × as long as the lamina, lamina 5–27 by 0.4–1.7 cm, index 5–20 or more, base gradually narrowed, widest at or below the middle, apex obtuse to narrowly acuminate. Sterile fronds with stalks to 6.5 cm, lamina 2–18.5 by 0.6–1.8 cm, index 2–15, base narrowed to attenuate, widest about the middle, apex sometimes obtuse, otherwise similar. *Venation*: veins distinct, veinlets simple or rarely forked, free, excurrent. Hydathodes absent or indistinct. Stellate hairs monomorphic, a thin mat, often fugacious, the straight rays boat-shaped. *Sori* apical, closely packed, 1.5–2.5 mm wide, 2 or 3 in each areole, deeply sunken. Sporangia long-stalked, paraphyses with short, straight rays. Spores with large and small protuberances. — **Fig. 26c, d.**

Distribution — *Malesia*: Moluccas, New Guinea; Bismarck Archipelago.

Habitat — Usually epiphytic in primary or secondary forest, often in mountain forest, occasionally on solitary trees, often near rivers, sometimes epilithic. Altitude (550–)1000–2100 m.

Note — Often confused with *P. lanceolata*, from which it can easily be distinguished by the larger sori within which paraphyses and sporangia are mixed.

b. var. *lauterbachii* (H. Christ) Hovenkamp

Pyrrosia foveolata (Alston) Morton var. *lauterbachii* (H. Christ) Hovenkamp, Blumea 30 (1984) 208; Leiden Bot. Ser. 9 (1986) 183. — *Niphobolus lauterbachii* H. Christ in K. Schum. & Laut., Fl. Schutzgeb. Südsee (1901) 142; Giesenh., Niphobolus (1901) 221, f. 20. — *Cyclophorus lauterbachii* C. Chr., Index Filic. (1906) 199; Alderw., Malayan Ferns (1908) 690. — *Pyrrosia lauterbachii* Ching, Bull. Chin. Bot. Soc. 1 (1935) 49. — Type: *Lauterbach 519b* (BO, L, P, SING), New Guinea.

Cyclophorus dispar H. Christ, Nova Guinea 8 (1909) 155; Alderw., Bull. Jard. Bot. Buitenzorg II, 1 (1911) 4, pl. 2, f. 2, 3; Malayan Ferns Suppl. (1917) 410. — *Pyrrosia dispar* Shing, Amer. Fern J. 73 (1983) 77. — Types: *Versteeg 1254* (B, BO, K, L, U, US), *1532* (B, BM, BO, K, L, P, U), New Guinea.

Differs from the type variety: *Rhizome* 1–1.2 mm thick. *Rhizome scales* 4–9.5 by 0.5–1 mm, entire, acumen dentate, shining brown. *Fronds* strongly dimorphic. Fertile fronds with stalks to 2 cm, lamina 2.3–16 by 0.2–0.5 cm, index 5–20 or more, linear. Sterile fronds with stalks up to 1 cm, lamina 1–5.5 by 0.3–1 cm, index 1–8, base cordate to cuneate, apex rounded to acuminate. Hydathodes absent. *Sori* 1 or 2 in each areole. — **Fig. 26a, b.**

Distribution — *Malesia*: New Guinea, Bismarck Archipelago.

Habitat — Epiphytic, on mossy branches, silt-loaded trunks, leaning trees etc. Altitude 100–1000 m.

Notes — 1. This variety occurs generally at lower altitudes than the type variety, but more or less transitional forms occur in the range of overlap. The discontinuity between the two varieties may be due to the absence of suitable habitats in the intermediate range.

2. Plants are occasionally infested with a gall-inducing sawfly, which causes the sori to swell. The formation of sporangia is suppressed in favour of paraphyses. This results in the formation of characteristically protruding tufts.

9. *Pyrrosia kinabaluensis* Hovenkamp

Pyrrosia kinabaluensis Hovenkamp, Blumea 30 (1984) 208; Leiden Bot. Ser. 9 (1986) 187. — Type: *Clemens 26984* (BM, BO, K, L, SING), Borneo.

Rhizome 1.2–3 mm thick, long-creeping, phylloids 2–5 cm apart, buds halfway along the internodes. Anatomy: vascular strands 6–8, sclerenchyma sheath distinct, sclerenchyma strands absent. *Rhizome scales* spreading, peltate, 2.6–4.4 by 0.4–0.8 mm, base entire to ciliate, acumen ciliate, light brown; rounded to ovate scales without acumen regularly present. *Fronds* moderately dimorphic, stalked. Fertile fronds with stalks to 1.5–5 cm long, 0.2–0.5 × as long as the lamina, lamina 7–19 by 0.7–1.2 cm, index 8–20, base narrowed, widest at or below the middle, apex obtuse to acute. Sterile fronds with stalks 0.5–3 cm, 0.1–0.5 × as long as the lamina, lamina 3–13 by 1–1.8 cm, index 3–8, otherwise similar to fertile fronds. *Venation*: veins distinct, veinlets forked and anastomosing. Hydathodes absent. Stellate hairs dimorphic, loose to appressed, forming a dense mat, whitish brown, the straight rays boat-shaped to

acicular. *Sori* all over the lamina, very closely packed, superficial, developing more or less simultaneously, soral area appearing acrostichoid when old. Sporangia stalked, paraphyses not differentiated. Spores with irregular ridges and protuberances.

Distribution — *Malesia*: Borneo.

Habitat — Epiphytic, sometimes epilithic, in deep shade. Altitude 100–1500 m.

Notes — 1. Has been confused with *P. rasamalai*, from which it differs in the ciliate rhizome scales and the markedly dimorphic fronds. Specimens have been identified as *Cyclophorus borneensis*, but the type of that is *P. rasamalai*.

2. This species is heterogeneous in several characters and possibly of hybrid origin, with *P. nummularifolia*, *P. rasamalai*, *P. christii* as candidates for parent species.

10. *Pyrrosia lanceolata* (L.) Farwell

Pyrrosia lanceolata (L.) Farwell, Amer. Midl. Nat. 12 (1930) 245; Ching, Bull. Chin. Bot. Soc. 1 (1935) 70; Hovenkamp, Leiden Bot. Ser. 9 (1986) 191. — *Acrostichum lanceolatum* L., Sp. Pl. 2 (1753) 1067; Sp. Pl. ed. 2 (1763) 1523; Burm. f., Fl. Ind. (1768) 228; Ching, Bull. Chin. Bot. Soc. 1 (1935) 46; Morton, J. Wash. Acad. Sc. 36 (1946) 168. — *Candollea lanceolata* Mirb. ex Desv., Mém. Soc. Linn. Paris 6 (1827) 224; Farwell, Amer. Midl. Nat. 12 (1930) 245. — *Niphobolus lanceolatus* Trimen, J. Linn. Soc. 24 (1888) 152, nom. illeg., non *N. lanceolatus* Keyserl. [= *Pleopeltis macrocarpa* (Willd.) Kaulf.]. — *Cyclophorus lanceolatus* Alston, J. Bot. London 69 (1931) 102; Backer & Posth., Varenfl. Java (1939) 238. — Type: *Herb. Hermann* (BM, L), Ceylon.

Polypodium adnascens Sw., Syn. Fil. (1806) 25, 222, pl. 2, f. 2; Willd., Sp. Pl. 5 (1810) 145; Baker, Syn. Fil. (1867) 349; Racib., Pterid. Buitenzorg (1898) 98; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 31. — *Cyclophorus adnascens* Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 300; Mém. Soc. Linn. Paris 6 (1827) 224; Alderw., Malayan Ferns (1908) 681; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 313. — *Niphobolus adnascens* Kaulf., Enum. (1824) 124; Blume, Enum. Pl. Javae (1828) 275; Fl. Javae Fil. (1829) 53; Giesenh., Niphobolus (1901) 196, 206, 209, f. 18. — *Pyrrosia adnascens* Ching, Bull. Chin. Bot. Soc. 1 (1935) 45; Holttum, Revis. Fl. Malaya 2 (1955) 144, f. 60; Copel., Fern Fl. Philipp. (1960) 471; Hoshiz., Bailey 21 (1981) 57, f. 2. — Type: *Rottler s.n.* (S, n.v.), India.

Cyclophorus glaber Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 301; Mém. Soc. Linn. Paris 6 (1827) 224. — *Niphobolus glaber* Kaulf., Enum. (1824) 127, nom. illeg., non *N. glaber* C. Presl (= *Microsorium punctatum*); C. Presl, Tent. Pterid. (1836) 202. — Type: *Commerston s.n.* (P), Java.

Niphobolus varius Kaulf., Enum. (1824) 125; Blume, Enum. Pl. Javae (1828) 106; Fl. Javae Fil. (1829) 54, pl. 21; C. Presl, Tent. Pterid. (1836) 201; Epim. Bot. (1851) 127; Giesenh., Niphobolus (1901) 151, 198, 208. — *Cyclophorus varius* Gaudich. in Freycin. Voy. Bot. (1829) 364; C. Chr., Index Filic. (1906) 201; Alderw., Malayan Ferns (1908) 682; Backer & Posth., Varenfl. Java (1939) 239, f. 57. — *Polypodium varium* Mett., Farngatt. I. Polypodium (1856) 126, nom. illeg., non *P. varium* L. (= *Polystichum* sp.); Racib., Pterid. Buitenzorg (1898) 100. — *Pyrrosia varia* Farwell, Amer. Midl. Nat. 12 (1931) 302; Ching, Bull. Chin. Bot. Soc. 1 (1935) 70; Holttum, Revis. Fl. Malaya 2 (1955) 146, f. 61; Copel., Fern Fl. Philipp. (1960) 471; Hoshiz., Bailey 21 (1981) 76, f. 13. — Type: *Chamisso s.n.* (B, LE n.v., P), 'Guaham & Manila'.

Niphobolus caudatus Kaulf., Enum. (1824) 127; Blume, Enum. Pl. Javae (1828) 106; Fl. Javae Fil. (1829) 56, pl. 22. — *Polypodium caudatum* Mett., Farngatt. I. Polypodium (1856) 126, nom. illeg., non *P. caudatum* Raddi, type from Brazil, nec *P. caudatum* Kaulf., type from Brazil. — *Pyrrosia caudata* Ching, Bull. Chin. Bot. Soc. 1 (1935) 46. — Type: *Willdenow herb.* 19728 (B: '*Pleopeltis commersoniana*').

Niphobolus koenigii Blume, Fl. Javae Fil. (1829) 50, footnote. — *Polypodium koenigii* Baker, Syn. Fil. (1867) 350. — Type: *Koenig s.n.* (L), Ceylon.

- Niphobolus carnosus* Blume, Enum. Pl. Javae (1828) 105; Fl. Javae Fil. (1829) 50, pl. 19; C. Presl, Tent. Pterid. (1836) 201; Epim. Bot. (1851) 126. — *Polypodium carnosum* Mett., Farn-gatt. I. Polypodium (1856) 124. — Type: *Blume s.n.* (?L, not found).
- Niphobolus elongatus* Blume, Enum. Pl. Javae (1828) 105; Fl. Javae Fil. (1829) 52, pl. 20; C. Presl, Tent. Pterid. (1836) 201; Epim. Bot. (1851) 126. — *Polypodium carnosum* var. *elongatum* Mett., Farn-gatt. I. Polypodium (1856) 124. — Type: *Blume s.n.* (L), Java.
- Niphobolus spathulifer* Bory in Bél., Voy. Ind. Or. Bot. 2 (1833) 24. — Type: *Bélanger s.n.* (P), Java.
- Niphobolus chamissonianus* C. Presl, Tent. Pterid. (1836) 201. — Type: *Chamisso s.n.* (PRC, n.v.).
- Polypodium pachydermum* Baker, J. Linn. Soc. Bot. 15 (1876) 108; Ann. Bot. (London) 5 (1891) 472. — *Cyclophorus pachydermus* C. Chr., Index Filic. (1906) 200; Alderw., Malayan Ferns (1908) 680. — *Pyrrosia pachyderma* Ching, Bull. Chin. Bot. Soc. 1 (1935) 47. — Type: *Moseley s.n.* (K), Kei Islands.
- Cyclophorus adnascens* var. *minor* Alderw., Malayan Ferns (1908) 681. — Type: *Raap 127* (BO), Batu Islands.
- Cyclophorus adnascens* forma *pernuda* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 10; Malayan Ferns Suppl. (1917) 411. — Type: *Gjellerup 806* (BO, L).
- Cyclophorus varius* var. *flabelliformis* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 57; Malayan Ferns Suppl. (1917) 412. — Type: *Matthew 702* (E, K, L), New Guinea.
- Cyclophorus adnascens* forma *dichotoma* Alderw., Bull. Jard. Bot. Buitenzorg III, 5 (1922) 192. — Type: *Docters van Leeuwen 1659* (?BO, not found), Salijer.
- Cyclophorus stellatus* Copel., J. Arnold Arbor. 24 (1929) 179. — *Pyrrosia stellata* Parris, Fern. Gaz. 12 (1980) 119. — Type: *Setchell s.n.*, March 1904 (A, US), New Guinea.
- Cyclophorus dimorphus* Copel., J. Arnold Arbor. 24 (1929) 180. — *Pyrrosia dimorpha* Parris, Fern. Gaz. 12 (1980) 119. — Type: *Brass 1575* (GH), New Guinea.
- Cyclophorus cornutus* Copel., Brittonia 1 (1931) 77, pl. 3. — *Pyrrosia cornuta* Tagawa, J. Jap. Bot. 22 (1949) 163; Wagner, Amer. J. Bot. 39 (1952) 587. — Type: *Clemens 21483* (K), Borneo.

Rhizome 1.2–2.1 mm thick, long-creeping, phyllo-pods 1–2 cm apart, buds about halfway on internodes. Anatomy: vascular strands 5(–7), sclerenchyma sheath distinct, a single central sclerenchyma strand usually present, rarely absent. *Rhizome scales* spreading, peltate, 1–7.8 by 0.3–1.3 mm, base entire to ciliate, acumen ciliate, hyaline light brown, usually with a hyaline margin; short, round or ovate scales without elongated acumen usually present. *Fronds* dimorphic, indistinctly to distinctly stalked. Fertile fronds with stalks to 5(–9) cm, lamina 3.5–31 by 0.3–3.5 cm, index 5–20 or more, base gradually narrowed, widest at or below the middle, apex obtuse to acute. Sterile fronds with stalks to 3(–5) mm, lamina 2–24 by 0.3–3.5(–4.3) cm, index 2–20, widest about or above the middle, apex rounded, obtuse, or acute. *Venation*: veins distinct or indistinct, veinlets simple, forked, or more copiously branched, mainly free, excurrent. Hydathodes absent, rarely present, few and indistinct. Stellate hairs monomorphic, a thin to dense mat, the straight rays boat-shaped to nearly acicular. *Sori* apical to all over the lamina, closely packed, 0.5–1(–2) mm wide, up to 10 in each areole, deeply sunken, developing acropetally. Sporangia long-stalked, paraphyses in a central bundle, with short, straight rays. Spores irregularly verrucate or with large and small protuberances.

Distribution — Africa; Southeast Asia to the Pacific. Throughout *Malesia*.

Habitat — Mostly epiphytic, also epilithic, rarely terrestrial. Common in a wide variety of situations. Mostly at low altitudes, sometimes up to 1000–1500 m.

Uses — Crushed and mixed with jintan itam and onion, then applied externally to relieve headache (Malaya); used to cure dysentery (Malaya).

Note — Intraspecific variation. Several species are here included in *P. lanceolata* which have widely been regarded as separate. In the Malesian area the most common and best recognisable forms have been named as:

‘*adnascens*’: Small plants, rather thick-leathery, with distinctly dimorphic fronds, the sterile ones often with rounded apex; rhizome scales short, mostly appressed. Throughout Malesia.

‘*varia*’: Larger plants, thin-leathery, with wider, less distinctly dimorphic fronds, the sterile ones often with acute apex; rhizome scales large, spreading. Throughout Malesia. Although the original name is based on material that clearly represents the previous form, the most widely used interpretation is based on Blume’s plate (1829: plate 21), which clearly represents this form.

‘*dimorpha*’: Relatively large plants, distinctly dimorphic, the sterile fronds often with rounded apex; rhizome scales often with a long entire filiform apex. Confined to New Guinea and surrounding islands.

‘*stellata*’: Small plants, similar to ‘*adnascens*’, but with a very dense, conspicuously whitish indument. Restricted to New Guinea and surrounding islands; similar forms not always distinct from ‘*adnascens*’ sporadically occur in other areas.

11. *Pyrrosia longifolia* (Burm. f.) Morton

Pyrrosia longifolia (Burm. f.) Morton, J. Wash. Acad. Sc. 36 (1946) 168; Holttum, Revis. Fl. Malaya 2 (1955) 148, f. 163; Hoshiz., Bailey 21 (1981) 67, f. 7; Hovenkamp, Leiden Bot. Ser. 9 (1986) 208. — *Acrostichum longifolium* Burm. f., Fl. Ind. (1768) 228. — *Candollea longifolia* Mirb., Hist. Nat. Vég. 5 (1803). — *Cyclophorus longifolius* Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 301; Mém. Soc. Linn. Paris 6 (1827) 224; Backer & Posth., Varenfl. Java (1939) 240. — *Niphobolus longifolius* Spr., Syst. 4 (1827) 45. — Type: *D. Pryon s.n.* (G, n.v.), Java.

Polypodium acrostichoides G. Forst., Prodr. (1786) 81; Sw., Syn. Fil. (1806) 29, 225, p.p.; Baker, Syn. Fil. (1867) 350; Giesenh., Niphobolus (1901) 151; Backer & Posth., Varenfl. Java (1939) 240. — *Cyclophorus acrostichoides* C. Presl, Epim. Bot. (1851) 130; Alderw., Malayan Ferns (1908) 683. — *Niphobolus acrostichoides* Bedd., Ferns Brit. India (1868) t. 81, non *N. acrostichoides* C. Presl, nom. nud. (= *Pyrrosia confluens*), nec *N. acrostichoides* J. Sm., J. Bot. (Hook.) 3 (1841) 396, nom. nud. (= *Pyrrosia sphaerosticha*); Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 325; Giesenh., Niphobolus (1901) 213. — *Pyrrosia acrostichoides* Ching, Bull. Chin. Bot. Soc. 1 (1935) 69; Copel., Fern Fl. Philipp. (1960) 471; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 50; Hovenkamp, Leiden Bot. Ser. 9 (1986) 208. — Type: *Forster s.n.* (BM, M).

Acrostichum bicolor Cav., Anal. Hist. Nat. 1 (1799) 103 [non *Niphobolus bicolor* Kaulf. and homotypic synonyms (= *Pyrrosia serpens*)]; C. Chr., Dansk Bot. Ark. 9 (1937) 7. — Type: *Née s.n.* (MA, teste C. Chr., l.c.), Luzon.

Cyclophorus scolopendrium Desv., Mém. Soc. Linn. Paris 6 (1827) 225; C. Presl, Epim. Bot. (1851) 132. — *Niphobolus scolopendrium* T. Moore, Index Filic. II (1861) 276. — Type: *Anonymous s.n.*, s.d. (P).

Niphobolus puberulus Blume, En. Pl. Javae (1828) 108; Fl. Javae Fil. (1829) 57, pl. 23; C. Presl, Tent. Pterid. (1836) 202; Epim. Bot. (1851) 130. — Type: *Blume s.n.* (BR, L, P), Java.

Niphobolus fissus Blume, En. Pl. Javae (1828) 106; Fl. Javae Fil. (1829) 58, pl. 24; C. Presl, Tent. Pterid. (1836) 202; Giesenh., Niphobolus (1901) 109. — *Gyrosorium fissum* C. Presl, Epim. Bot. (1851) 141. — *Polypodium fissum* Baker, Syn. Fil. (1867) 351. — *Cyclophorus acrostichoides* var. *fissum* Bonap., Notes Ptérid. 7 (1918) 125. — *Pyrrosia fissa* Mehra, Ferns of Mussoorie (1939) 26 (‘*fissus*’). — Type: *Blume s.n.* (L), Java.

- Polypodium macropodium* Baker, J. Linn. Soc. Lond. 15 (1876) 108; Hemsl., Chall. Exp. (1885) 210. — *Cyclophorus macropodus* C. Chr., Index Filic. (1906) 199; Alderw., Malayan Ferns (1908) 683. — *Pyrrosia macropoda* Ching, Bull. Chin. Bot. Soc. 1 (1935) 70. — Type: *Moseley s.n.* (BM, K), Aru Islands.
- Cyclophorus acrostichoides* var. *gracilis* Copel., Leaflet Philipp. Bot. 1 (13) (1907) 234; Alderw., Malayan Ferns (1908) 683. — Types: *Elmer 7751* (BO, K, M, Z), 7867 (n.v.).
- Cyclophorus valliculatus* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 10; Malayan Ferns Suppl. (1917) 412; Backer & Posth., Varenfl. Java (1939) 241. — Type: *Backer 1229* (BO), Java.
- Cyclophorus acrostichoides* var. *backeri* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 10; Malayan Ferns Suppl. (1917) 412. — Type: *Backer 2936* (?BO, not traced), Java.
- Cyclophorus acrostichoides* forma *carnosa* Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 8; Malayan Ferns Suppl. (1917) 412. — Type: *Brooks 203-S* (BM, L), Sumatra.
- Cyclophorus cinnamomeus* Alderw., Bull. Jard. Bot. Buitenzorg III, 5 (1922) 192; Backer & Posth., Varenfl. Java (1939) 240. — Type: *Backer 31539* (BO), Java.
- Pyrrosia coccideisquamata* Gilli, Ann. Nat. Mus. Wien 81 (1978) 26. — Type: *Gilli 603* (W), New Guinea.

Rhizome 1.8–2.7 mm thick, long-creeping, phylloids 2–6 cm apart, buds about halfway along the internodes. Anatomy: vascular strands 5–7, sclerenchyma sheath distinct, sclerenchyma strands many, scattered within the vascular cylinder, sometimes confluent and almost replacing the parenchyma. *Rhizome scales* appressed, pelate, 1–3.4 by 0.6–1.5 mm, entire, shining brown or blackish with a distinct hyaline margin. *Fronde* monomorphic, indistinctly to distinctly stalked, stalks to 0.5–10(–22) cm, lamina 10–110 by 0.7–2(–4.5) cm or longer, strap-shaped, base gradually narrowed, apex rounded to acute. *Venation*: veins distinct or indistinct, veinlets simple or occasionally forked, free, excurrent. Hydathodes absent. Stellate hairs monomorphic, appressed, a thin to dense mat, the straight rays boat-shaped. *Sori* apical, closely packed, c. 1 mm wide, several in each areole, deeply sunken, developing acropetally. Sporangia long-stalked, paraphyses in a central bundle, with short, straight rays. Spores irregularly verrucate.

Distribution — Indochina to the Pacific and Australia (Queensland). Throughout *Malesia*.

Habitat — Epiphytic, high or low, rarely epilithic or terrestrial, in various types of forest, also frequently in disturbed or open situations and in the littoral zone, in mangrove. Altitude from sea level to 300(–1000) m.

Notes — 1. Small plants may be confused with *P. lanceolata*, but can be recognised by the monomorphic, very stiff-leathery fronds, the thicker, rigid rhizome and the entire, short, appressed rhizome scales.

2. *Niphobolus fissus* Blume has frequently been misinterpreted, and reports under this name (and its synonyms) from outside the distribution area of *P. longifolia* as outlined here refer to either *P. mannii* (Giesenh.) Ching or to *P. porosa*.

12. *Pyrrosia novo-guineae* (H. Christ) M.G. Price

- Pyrrosia novo-guineae* (H. Christ) M.G. Price, Kalikasan 3 (1974) 177; Ravensberg & Hennipman, Leiden Bot. Ser. 9 (1986) 301. — *Drymoglossum novo-guineae* H. Christ in K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1901) 137; Alderw., Malayan Ferns (1908) 703; C. Chr., Dansk Bot. Ark. 6 (1929) 89, pl. 11, f. 2. — *Cyclophorus novo-guineae* Nakai, Bot. Mag. Tokyo (1926) 386. — Type: *Lauterbach 570* (?B, not traced), New Guinea.

- Cyclophorus bamleri* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 10 (1912) 339. — Type: *Rosenstock Fil. Novog. Exsicc.* 107 (*Bamler S 75*) (A, B, BM, K, L, MICH, P), New Guinea. *Drymoglossum crassifolium* Brause, Bot. Jahrb. Syst. 49 (1912) 35; Alderw., Malayan Ferns Suppl. (1917) 419; Brause, Bot. Jahrb. Syst. 56 (1921) 177; C. Chr., Dansk Bot. Ark. 6 (1929) 88, pl. 12, f. 3. — Type: *Schlechter 19864* (B), New Guinea.
- Cyclophorus ledermannii* Brause, Bot. Jahrb. Syst. 56 (1920) 206. — Type: *Ledermann 8840* (B), New Guinea.

Rhizome c. 1.5 mm thick, long-creeping, phylloids 1.5–4 cm apart, buds halfway along the internodes. Anatomy: vascular strands 5, sclerenchyma sheath distinct, a single, central sclerenchyma strand present. *Rhizome scales* spreading, peltate, up to 4 by 0.4 mm, entire, acumen hyaline. *Fronde* dimorphic, stalked. Fertile fronds with stalks 0.5–8 cm long, lamina 8–22 by 0.25–0.6 cm, linear. Sterile fronds with stalks up to 2.5(–5) cm, lamina (3–)5–14.5(–20) by 1.2–3.5 cm, index 2–7(–20), widest near the middle. *Venation*: veins distinct, veinlets branched and often anastomosing, free veinlets mostly excurrent. Hydathodes absent. Stellate hairs monomorphic, forming a thin mat, often fugaceous, hyaline, the straight rays acicular. *Coenosori* extending to the base of the lamina. Sporangia long-stalked, paraphyses with short, straight rays. Spores with longitudinal ridges.

Distribution — *Malesia*: New Guinea.

Habitat — Epiphytic on trunks or branches in rain forests. Altitude from sea level to 1000(–1200) m.

13. *Pyrrosia nummularifolia* (Sw.) Ching

- Pyrrosia nummularifolia* (Sw.) Ching, Bull. Chin. Bot. Soc. 1 (1935) 52; Holttum, Revis. Fl. Malaya 2 (1955) 144, f. 59; Copel., Fern Fl. Philipp. (1960) 475; Hoshiz., Bailey 21 (1981) 69, f. 9A; Hovenkamp, Leiden Bot. Ser. 9 (1986) 214. — *Acrostichum nummulariifolium* Sw., Syn. Fil. (1806) 191, 419, pl. 2, f. 1; Willd., Sp. Pl. 5 (1810) 100. — *Gymnopteris nummulariifolium* C. Presl, Tent. Pterid. (1836) 244. — *Niphobolus nummulariifolius* J. Sm., J. Bot. (Hook.) 3 (1841) 396; Giesenh., Niphobolus (1901) 179; Copel., Polypod. Philipp. (1905) 114. — *Galeoglossa nummulariifolia* C. Presl, Epim. Bot. (1851) 133. — *Polypodium nummulariifolium* Mett., Farngett. I. Polypodium (1856) 123, pl. 3, f. 9–10; Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 230; Baker, Syn. Fil. (1867) 351; Racib., Pterid. Buitenzorg (1898) 101. — *Cyclophorus nummulariifolius* C. Chr., Index Filic. (1906) 200; Alderw., Malayan Ferns (1908) 685; Backer & Posth., Varenfl. Java (1939) 239, f. 58; Dickason, Ohio J. Sc. 46 (1946) 129. — Type: *Thunberg s.n.* (S, n.v.), Java.

- Acrostichum obovatum* Blume, Enum. Pl. Javae (1828) 102; Fl. Javae Fil. (1829) 35, pl. 11, f. 3. — *Niphobolus obovatus* Kunze, Bot. Zeitung (Berlin) 6 (1848) 120. — *Galeoglossa obovata* C. Presl, Epim. Bot. (1851) 133. — *Polypodium obovatum* Mett., Farngett. I. Polypodium (1856) 124; Racib., Pterid. Buitenzorg (1898) 101. — *Polypodium nummulariifolium* var. *obovatum* Clarke, Trans. Linn. Soc. London II, Bot. 1 (1880) 554. — *Cyclophorus obovatus* Alderw., Malayan Ferns (1908) 685. — *Pyrrosia obovata* Ching, Bull. Chin. Bot. Soc. 1 (1935) 47; Hoshiz., Bailey 21 (1981) 69, f. 9B. — *Cyclophorus nummulariifolius* var. *obovatus* Bonap., Notes Ptérid. 7 (1918) 126. — Type: *Blume s.n.* (L), Java.

- Acrostichum nummulariifolium* var. *subpeltatum* Blume, Fl. Javae Fil. (1829) 33, pl. 11, f. 2. — *Galeoglossa rotundifolia* C. Presl, Epim. Bot. (1851) 133. — *Niphobolus rotundifolia* Fée, Gen. Filic. (1850–1852) 262. — Type: not indicated (?L, not traced), Java.

- Cyclophorus nummulariifolius* var. *rufus* Alderw., Bull. Dép. Agric. Indes Néerl. 21 (1908) 8; Malayan Ferns (1908) 685. — *Pyrrosia nummulariifolia* var. *rufa* Ching, Bull. Chin. Bot. Soc. 1 (1935) 47; Tagawa & Iwats., Acta Phytotax. Geobot. 23 (1968) 52. — Type: *Raap 742* (BO), Sumatra.

Rhizome 0.6–1.6 mm thick, long-creeping, phyllopods 0.5–1.5 cm apart, buds half-way along the internodes to opposite the phyllopods. Anatomy: vascular strands 3–7, sclerenchyma sheath distinct, a single, central sclerenchyma strand sometimes present. *Rhizome scales* spreading, peltate, 3.3–5.7 by 0.3–0.7 mm, base entire to ciliate, acumen ciliate, light brown; short, round to ovate scales without acumen regularly present. *Fronds* dimorphic. Fertile fronds with stalks up to 2.5 cm, to 0.5(–1) × as long as the lamina, lamina 1.5–12.5 by 0.3–1.1 cm, index 3–20 or more, base narrowed, widest near the middle, apex rounded. Sterile fronds sessile or with stalks to 2.5 cm, to 0.5 × as long as the lamina, lamina 0.8–5 by 0.6–2(–3) cm, index 1–2(–4), widest below or at the middle. *Venation*: veins not distinct in the mesh of branched and anastomosing veinlets, free veinlets many, mostly excurrent. Hydathodes absent. Stellate hairs dimorphic, forming a thick mat, whitish with a distinct brownish upper layer composed of hairs with acicular rays. *Sori* all over the lamina or in an irregular patch, 1–1.5 mm wide, superficial, several in each areole, developing acropetally, mostly immersed in the hairs. Sporangia long-stalked, paraphyses not differentiated. Spores with irregular ridges and protuberances.

Distribution — Western Indochina to the Himalayas; in *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Java, Lesser Sunda Islands, Philippines, Sulawesi.

Habitat — Epiphytic, often as high epiphyte or in exposed sites, often epilithic, preferably on limestone. Altitude from sea level to 1200 m.

Notes — 1. Dimorphism. The sterile fronds are often appressed to the substrate, with the fertile fronds standing out. Intermediate, partly fertile fronds may occur, perhaps most frequently under adverse conditions.

2. Especially when sterile this species may be confused with *P. piloselloides* which has a similar habitus and habitat. *Pyrrosia nummularifolia* is always distinct in the dense, dimorphic indument.

3. The fronds are markedly succulent, with water-tissue often taking up more than half of the total thickness that may reach 1 mm.

14. *Pyrrosia penangiana* (Hook.) Holttum

Pyrrosia penangiana (Hook.) Holttum, Revis. Fl. Malaya 2 (1955) 146, f. 62; Tagawa & Iwats., Acta Phytotax. Geobot. 23 (1968) 52; Hovenkamp, Leiden Bot. Ser. 9 (1986) 218. — *Niphobolus penangianus* Hook., Ic. Pl. 3 (1840) pl. 203; Gen. Fil. (1842) pl. 83; Giesenh., Niphobolus (1901) 97. — *Polycampium penangianum* C. Presl, Epim. Bot. (1851) 136. — *Polypodium penangianum* Hook., Sp. Fil. 5 (1864) 52; Baker, Syn. Fil. (1867) 352. — *Cyclophorus penangianus* C. Chr., Index Fil. (1906) 200; Alderw., Malayan Ferns (1908) 686; Backer & Posth., Varenfl. Java (1939) 242; Dickason, Ohio J. Sc. 46 (1946) 129. — Type: *Dalhousie s.n.* (E, K), Penang. *Niphobolus mollis* Kunze, Bot. Zeitung (Berlin) 6 (1848) 121; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 31. — *Cyclophorus mollis* C. Presl, Epim. Bot. (1851) 131; Alderw., Malayan Ferns (1908) 688; Dickason, Ohio J. Sc. 46 (1946) 129. — *Pokypodium molle* Mett., Farngett. I. Polypodium (1856) 128, nom. illeg., non Schreb. (= *Athyrium filix-femina*). — *Pyrrosia mollis* Ching, Bull. Chin. Bot. Soc. 1 (1935) 53; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 31. — Type: *Zollinger 3183* (B, L, Z), Java. *Cyclophorus brevipes* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 139. — Type: *Docters van Leeuwen s.n.*, Jan. 1920 (BO, L), Sumatra.

Rhizome 3–6 mm thick, short, phyllopods contiguous. Anatomy: vascular strands (5)–8–15, sclerenchyma sheath distinct, sclerenchyma strands many, scattered. *Rhi-*

zome scales spreading, pseudopeltate, 2.6–9.4 by 0.7–1.3 mm, base entire, acumen entire to denticulate, light brown. *Fronds* monomorphic, sessile, 11–72 by 1–8 cm, index 6–20 or more, base gradually narrowed, widest above the middle, apex acute to acuminate. *Venation*: veins distinct, veinlets simple or rarely forked, free, excurrent. Hydathodes distinct. Stellate hairs monomorphic, a sparse to dense mat, sometimes fugacious, brown, straight rays acicular. *Sori* apical, closely packed to shortly spaced, 1.5–2.5 mm wide, 2 sporangia, several in a row in each areole, superficial, developing acropetally. Sporangia stalked, paraphyses not differentiated. Spores finely and sparsely granulate.

Distribution — Southwestern Indochina. *Malesia*: Peninsular Malaysia, Sumatra, Java, Lesser Sunda Islands.

Habitat — Mostly epiphytic, in forest or on solitary trees, also epilithic, sheltered, preferably on limestone. Low altitudes to 500 m in the western part of its range, to 1550 m in the drier eastern parts.

Notes — 1. Small forms have been confused with *P. porosa*, e.g. by Ching (1935). *Pyrrosia penangiana* can be recognised by the short rhizome with pseudopeltate, nearly entire scales, and by the strictly monomorphic indument.

2. Specimens from the drier, eastern part of the range are often more compact, and have a denser layer of hairs than specimens from the everwet western part.

15. *Pyrrosia piloselloides* (L.) M.G. Price

Pyrrosia piloselloides (L.) M.G. Price, *Kalikasan* 3 (1974) 176; Ravensberg & Hennipman, *Leiden Bot. Ser.* 9 (1986) 302; Zamora & Co, *Guide Philipp. Flora & Fauna* II (1986) 32. — *Pteris piloselloides* L., *Sp. Pl.* 2, ed. 2 (1763); *Burm. f., Fl. Ind.* (1768) 229; Sw., *Syn. Fil.* (1806) 94; Blanco, *Fl. Filip.* (1837) 830. — *Taenitis piloselloides* R. Br., *Prodr. Fl. Nov. Holl.* (1810) 154. — *Notochlaena piloselloides* Kaulf., *Enum.* (1824) 133; Blume, *Enum. Pl. Javae* (1828) 108; *Fl. Javae Fil.* (1829) 67. — *Pteropsis piloselloides* Desv., *Mém. Soc. Linn. Paris* 6 (1827) 218; Copel., *Gen. Fil.* (1947) 10; *Fern Fl. Philipp.* (1960) 475. — *Drymoglossum piloselloides* C. Presl, *Tent. Pterid.* (1836) 227, pl. 10, f. 5–6; *Epim. Bot.* (1851) 157; *Racib., Pterid. Buitenzorg* (1898) 61; C. Chr., *Dansk Bot. Ark.* 6 (1929) 86, pl. 12, 13; Backer & Posth., *Varenfl. Java* (1939) 243; *Holtum, Revis. Fl. Malaya* 2 (1955) 149. — *Elaphoglossum piloselloides* Keyserl., *Polyp. Cyath. Herb. Bunge* (1873) 36. — *Lemmaphyllum piloselloides* Luer., *Bot. Zbl.* 11 (1882) 78. — *Oetosis piloselloides* Kuntze, *Rev. Gen. Pl.* 2 (1891) 817. — Type: *Burman s.n.*, 1759 (G, herb. Delessert), Java.

Drymoglossum rotundifolium C. Presl, *Epim. Bot.* (1851) 157. — Type: *Anonymous s.n.* (PRC), India.

Drymoglossum piloselloides var. *platycerioides* Teruya, *Acta Phytotax. Geobot.* 1 (1932) 198. — Type: *Teruya s.n.* (?KYO, n.v.), Malaya.

Drymoglossum heterophyllum auct. non (L.) Trimen: Alderw., *Malayan Ferns* (1908) 703; Copel., *Sarawak Mus. J.* 2 (1917) 410; Goebel, *Ann. Jard. Bot. Buitenzorg* 26 (1926) 140.

Rhizome c. 1 mm thick, long-creeping, phylloids 0.8–2.5 cm apart, buds about halfway along the internodes. Anatomy: vascular strands 3 or 4, sclerenchyma sheath distinct, sclerenchyma strand single, central. *Rhizome scales* spreading, peltate, up to 1 by 0.8 mm, ciliate, acumen very short, central region brown, margin lighter. *Fronds* strongly dimorphic, short-stalked. Fertile fronds with stalks up to 0.5(–1) mm long, lamina (2.5–)4–16(–25) by 0.3–1.5 cm, linear. Sterile fronds with lamina 1–7 by 1–2 cm, index 1–6, widest at or above the middle. *Venation*: veins not distinct in the mesh of anastomosing veinlets, free veinlets simple or forked, recurrent. Hydathodes ab-

sent. Stellate hairs monomorphic, forming a sparse mat, hyaline, the rays acicular. *Coenosorus* apical or extending to the base of the lamina, submarginal. Sporangia long-stalked, paraphyses with straight rays. Spores tuberculate and with conical warts.

Distribution — Northeast India to Hainan. Throughout *Malesia*.

Habitat — Usually epiphytic, sometimes epilithic, in all types of primary and secondary vegetation. Common to very common in most of its localities. Altitude from sea level to 1000 m.

Notes — 1. One of the most common epiphytes of the Malesian lowlands. The appressed, sterile fronds of newly settled plants form characteristic, two-rowed series of 'buttons' on otherwise bare tree bark. Older plants may completely overgrow entire trees, with sometimes fatal effects.

2. In the past the present species was often confused with *P. heterophylla*, a very similar species confined to southern India and Sri Lanka. It may also be confused with *Lemmaphyllum carnosum* and *Pyrrosia nummularifolia*, which share the characteristic habit and have a similar habitat.

16. *Pyrrosia platyphylla* Hovenkamp

Pyrrosia platyphylla Hovenkamp, Blumea 30 (1984) 207; Leiden Bot. Ser. 9 (1986) 36. — Type: Elmer 20659 (L, A, B, BM, BO, BR, K, M, P, SING, U, Z), Borneo.

Rhizome 4–4.5 mm thick, shortly elongated, phyllopods 1–2 cm apart. Anatomy: vascular strands 9–11, ground tissue completely sclerified. *Rhizome scales* spreading, basifixed, 3–10 mm long, base often ciliate, acumen entire, brown; small scales often interspersed with the larger ones. *Fronds* monomorphic, sessile or indistinctly stalked, 26–111 by 2.5–7.3(–10) cm, index 7–20, base very gradually narrowed, widest above the middle, apex acuminate. *Venation*: veins distinct, veinlets much branched and strongly anastomosing, free veinlets excurrent and recurrent. Hydathodes distinct. Stellate hairs dimorphic, a dense mat, greyish brown, the straight upper rays appressed, narrowly boat-shaped to acicular. *Sori* apical, closely packed, 0.5 mm wide, containing c. 10 sporangia, many scattered over each areole, superficial, developing acropetally. Sporangia sessile or short-stalked, paraphyses not differentiated. Spores smooth.

Distribution — *Malesia*: Borneo.

Habitat — Epiphytic to 40 m high, or epilithic, preferably on limestone. Altitude from sea level up to 600 m.

Note — Has been confused with *P. costata*, from Continental Asia. *Pyrrosia platyphylla* differs most strikingly in the costa being triangular in cross section, not quadrangular as in true *P. costata*. It can be confused also with *P. princeps*, which has a shorter rhizome, with the phyllopods contiguous.

17. *Pyrrosia porosa* (C. Presl) Hovenkamp var. *porosa*

Pyrrosia porosa (C. Presl) Hovenkamp var. *porosa*, Blumea 30 (1984) 208; Leiden Bot. Ser. 9 (1986) 226. — [*Polypodium porosum* Wall., Cat. (1829) n. 266, nom. nud.] — *Niphobolus porosus* C. Presl, Tent. Pterid. (1836) 200. — *Cyclophorus porosus* C. Presl, Epim. Bot. (1851) 130; Alderw., Malayan Ferns (1908) 687, p.p. — *Polypodium porosum* Mett., Farngett. I. Polyp. (1856) 128. — Type: Wallich 266 (PRC, teste Holttum; iso B, BM, BR, K, M, P, US), India.

Nipholobolus sticticus Kunze, Linnaea 24 (1851) 257; Giesenh., *Nipholobolus* (1901) 135. — *Polypodium sticticum* Mett., Farngett. I. Polyp. (1856) 128. — *Cyclophorus sticticus* C. Chr., Index Filic. (1906) 201; Alderw., Malayan Ferns (1908) 687, p.p. — *Pyrrosia stictica* Holttum, Nov. Bot. Inst. Univ. Car. Prag. (1968) 31, nom. superfl. — Type: *Leschenault* 149 (G, n.v., P), India. *Pyrrosia mollis* auct. non (Kunze) Ching: Ching, Bull. Chin. Bot. Soc. 1 (1935) 53; Copel., Fern Fl. Philipp. (1960) 473. *Polypodium fissum* auct. non Blume (Baker): Racib., Pterid. Buitenzorg (1898) 102. *Nipholobolus flocciger* and homotypic synonyms, auct. non Blume: Alderw., Malayan Ferns (1908) 687, p. p.

Rhizome 1.6–3.1 mm thick, short, phyllopods 0.3–0.7 cm apart. Anatomy: vascular strands 5–13, sclerenchyma sheath distinct, sclerenchyma strands 15–many, scattered. **Rhizome scales** spreading; peltate, 1.4–5.7 by 0.5–2.1 mm, base entire to ciliate, acumen dentate to ciliate, light brown to blackish with a lighter margin. **Fronde** monomorphic, sessile or indistinctly stalked to 13 cm, 9–31 by 0.7–3.5 cm, index 6–20 or more, base gradually narrowed, widest above the middle, apex acute to acuminate. **Venation**: veins distinct, veinlets simple or rarely forked, free, excurrent. Hydathodes distinct. Stellate hairs dimorphic, a dense mat, brown, the straight rays acicular. **Sori** apical to all over the lamina, closely packed, 1–2 mm wide, several in a row in each areole, superficial, developing acropetally. Sporangia short-stalked, paraphyses not differentiated. Spores finely granulate.

Distribution — From India to Japan, Taiwan and Indochina. In *Malesia*: Philippines (Luzon).

Habitat — Epilithic or epiphytic, sometimes terrestrial. Altitude to 2250 m.

Notes — 1. This species has been reported under the misinterpreted name *Nipholobolus fissus* and has been confused with *P. penangiana* (as *N. mollis*) and *N. rasamalae* (as *N. flocciger*).

2. A predominantly continental species with the Malesian occurrence restricted to northern Luzon in the Philippines.

18. *Pyrrosia princeps* (Mett.) Morton

Pyrrosia princeps (Mett.) [Copel., Fern Fl. Philipp. (1960) 474, comb. inval.] Morton, Amer. Fern J. 60 (1970) 118; Hovenkamp, Leiden Bot. Ser. 9 (1986) 231. — *Polypodium princeps* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 232; Baker, Syn. Fil. (1867) 351; Becc., Malesia 3 (1890) 48. — *Nipholobolus princeps* Giesenh. ex Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 325. — *Cyclophorus princeps* C. Chr., Index Filic. (1906) 200; Alderw., Malayan Ferns (1908) 684. — Type: *Zippelius s.n.* (L), New Guinea. *Cyclophorus aglaophyllus* Copel., J. Arnold Arbor. 24 (1929); Fern Fl. Philipp. (1960) 474. — Type: *Brass* 1143 (GH), New Guinea.

Rhizome to 5 mm thick, not elongated, phyllopods contiguous. Anatomy: vascular strands c. 10, ground tissue completely sclerified. **Rhizome scales** spreading, basifixed, 4.5–10 mm long, base dentate to ciliate, acumen dentate or with long, sometimes curly cilia, light brown; small scales often interspersed with the larger ones. **Fronde** monomorphic, sessile or indistinctly to 13 cm stalked, lamina 24–125 by 3.4–12 cm, index 6–14, base very gradually narrowed, widest above the middle, apex acuminate. **Venation**: veins distinct, veinlets much branched and strongly anastomosing, free veinlets excurrent and recurrent. Hydathodes distinct. Stellate hairs dimorphic, a dense mat, brown to greyish brown, the straight upper rays appressed or



Fig. 27. *Pyrrosia princeps* (Mett.) Morton. a. Habit; b. rhizome scale; c. sori (Brass 8859). Scale bars: a = 2 cm, b = 1 mm, c = 0.5 mm. Drawings J. Wessendorp. Reproduced from Hovenkamp 1986.

patent, acicular, one central, elongated, erect ray sometimes present. *Sori* apical, closely packed, 0.5 mm wide, containing c. 10 sporangia, many scattered over each areole, superficial, developing acropetally. Sporangia sessile, paraphyses not differentiated. Spores smooth. — **Fig. 27.**

Distribution — *Malesia*: Sulawesi (one locality), Moluccas, New Guinea.

Habitat — Mostly epilithic or terrestrial, often near rivers, also on limestone cliffs and steep hillsides, or epiphytic, on rain forest trees or in secondary forest or plantations. Altitude from sea level to 1000 m.

Note — *Pyrrosia princeps* has been confused with *P. platyphylla* and *P. splendens*. It can usually be distinguished from both by the indument, which has an upper layer of hairs with erect, spreading rays. However, forms occur which closely resemble *P. splendens* (with erect, elongated central rays) or *P. platyphylla* (with appressed rays only). The rhizome scales display the most constant distinguishing character; they are dentate to ciliate in *P. princeps*, whereas at least the acumen is entire in *P. splendens* and *P. platyphylla*. Detached fronds, however, cannot always be identified with certainty.

19. *Pyrrosia rasamalae* (Racib.) Shing

Pyrrosia rasamalae (Racib.) Shing, Amer. Fern J. 73 (1983) 78; Hovenkamp, Leiden Bot. Ser. 9 (1986) 233. — *Polypodium rasamalae* Racib., Pterid. Buitenzorg (1898) 99. — *Niphobolus rasamalae* Giesenh., Festschr. zu S. Schwendener (1899) 12; *Niphobolus* (1901) 187. — *Cyclophorus rasamalae* C. Chr., Index Filic. (1906) 200; Alderw., Malayan Ferns (1908) 686; Backer & Posth., Varenfl. Java (1939) 240; Holttum, Revis. Fl. Malaya 2 (1955) 147. — Type: *Raciborski* 83 (BO, K, L, M, P, US), Java.

Antrophyum niphoboloides Kunze, Bot. Zeitung (Berlin) (1848) 209. — *Taenitis niphoboloides* T. Moore, Index Filic. (1857) 30, 81 [non *T. niphoboloides* Luerss. (1883), = *Pyrrosia niphoboloides*]. — Type: *Zollinger* 2223 (BM, L, P), Java.

Niphobolus lanuginosus Giesenh., *Niphobolus* (1901) 190. — *Cyclophorus lanuginosus* C. Chr., Index Filic. (1906) 199; Alderw., Malayan Ferns (1908) 685. — *Pyrrosia lanuginosa* Copel., Fern Fl. Philipp. (1960) 472. — Type: *A. Loher* 1266 (M, P), Luzon.

Cyclophorus rasamalae forma *minor* Alderw., Bull. Dép. Agric. Indes Néerl. 18 (1908) 8. — Type: *J.J. Smith s.n.* (BO), Java.

Cyclophorus borneensis Copel., Philipp. J.Sc., Bot. 12 (1917) 64; Sarawak Mus. J. 2 (1917) 409. — *Pyrrosia borneensis* Shing, Amer. Fern J. 73 (1983) 78. — Type: *Topping* 1508 (GH), Borneo.

Niphobolus flocciger and homotypic synonyms, auct. non Blume: *Racib.*, Pterid. Buitenzorg (1898) 101; Giesenh., *Niphobolus* (1901) 189; Alderw., Malayan Ferns (1908) 687, p.p.; C. Chr. & Holttum, Gard. Bull. Str. Settlement. 7 (1934) 313; Ching, Bull. Chin. Bot. Soc. 1 (1935) 71; Backer & Posth., Varenfl. Java (1939) 243; Holttum, Revis. Fl. Malaya 2 (1955) 147; Copel., Fern Fl. Philipp. (1960) 473.

Rhizome 1–3 mm thick, long-creeping, phylloids 1–5 cm apart, buds in the lower half of the internodes. Anatomy: vascular strands 4–8, sclerenchyma sheath distinct, sclerenchyma strands up to 10, scattered. *Rhizome scales* spreading, peltate, 4–9.5 by 0.4–1.4 mm, base entire, acumen ciliate, shining light brown or hyaline, rounded to ovate scales without acumen regularly present. *Fronds* monomorphic, stalked, stalks to 1–10 cm long, to 0.25(–0.5) × as long as the lamina, lamina 3.5–36 by 0.3–1.4 cm, linear, base narrowed, widest at or below the middle, apex obtuse to acute. *Venation*: veins distinct, veinlets simple, free, excurrent. Hydathodes absent. Stellate hairs dimorphic, forming a dense mat, light brown, the straight rays boat-shaped to acicular,

separate from the lower layer. *Sori* apical or all over the lamina, closely packed, 2 or 3 in a row in each areole, superficial, developing acropetally. Sporangia stalked, paraphyses not differentiated. Spores with irregular ridges and protuberances.

Distribution — *Burma. Malesia*: Sumatra, Peninsular Malaysia, Java, Borneo, Lesser Sunda Islands, Philippines (N Luzon).

Habitat — Epiphytic, often as high epiphyte, in various types of forest or plantations, on wayside trees etc., occasionally epilithic or on earthbanks. Altitude 500–1500 m, occasionally to 1900 m.

Notes — 1. This species has often been named *P. floccigera*, properly a synonym of *P. albicans*.

2. Large forms have been separated as *Niphobolus lanuginosus*, but there is a gradual transition between these and smaller forms.

20. *Pyrrosia samarensis* (C. Presl) Ching

Pyrrosia samarensis (C. Presl) Ching, Bull. Chin. Bot. Soc. 1 (1935) 49; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 34; M.G. Price, Philipp. J. Biol. 2 (1973) 110; Hoshiz., Bailey 21 (1981) 73, f. 12; Hovenkamp, Leiden Bot. Ser. 9 (1986) 239; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 194. — *Gyrosorium samarense* C. Presl, Epim. Bot. (1851) 140. — *Niphobolus samarensis* Fée, Gen. Filic. (1850–1852) 263; Giesenh., *Niphobolus* (1901) 191. — *Polypodium samarense* Mett., Farngatt. I. Polypodium (1856) 123, pl. 3, f. 1–4. — *Cyclophorus samarensis* C. Chr., Index Filic. (1906) 200; Alderw., Malayan Ferns (1908) 691. — Type: *Cuming* 323 (PRC, teste Holttum; B, BM, K, P), Samar.

Cyclophorus argyrolepis H. Christ, Bull. Herb. Boiss. II, 6 (1906) 991; Alderw., Malayan Ferns (1908) 694. — Type: *Loher s.n.*, March 1906 (P), Luzon.

Pyrrosia philippinensis Copel., Philipp. J. Sc. 81 (1952) 43, nom. superfl.; Fern Fl. Philipp. (1960) 471. — Type: *Ramos* 946 (M, U, US, Z), Luzon.

Rhizome 1.5–3 mm thick, long-creeping, phylloids (1.5–)3–5 cm apart, buds about halfway along the internodes. Anatomy: vascular strands c. 10, sclerenchyma sheath distinct, sclerenchyma strands c. 15, mainly peripheral. *Rhizome scales* spreading to squarrose, peltate, 7–8 by 0.6–0.9 mm, entire, hyaline. *Fronds* dimorphic, stalked. Fertile fronds with stalks 1–6 cm long, to 0.15–0.25 × as long as the lamina, lamina 17–37 by 0.8–2.2 cm, base narrowed, widest in the basal part, apex contracted to a narrow fertile spike. Sterile fronds with stalks to 9 cm, to 0.5 × as long as the lamina, lamina 13.5–42 by 14.4 cm, index 10–20, base narrowed, widest below the middle, apex acute. *Venation*: veins distinct, veinlets frequently forked, sometimes more copiously branched, frequently anastomosing, free veins many, mainly excurrent. Hydathodes absent. Stellate hairs dimorphic, forming a dense mat, dirty whitish, the straight rays acicular, often brown, usually forming a sparse upper layer. *Coenosorus* on an apical spike, occasionally interrupted below, medial between costa and lamina, 2–4 mm wide, developing acropetally. Sporangia long-stalked, paraphyses inconspicuous, with short, straight rays. Spores with longitudinal ridges.

Distribution — *Malesia*: Philippines.

Habitat — Epiphytic, in forest. Low altitude up to 750 m.

Note — Sterile plants of *P. angustata* and *P. samarensis* are difficult to distinguish. In *P. angustata* the indument is less distinctly differentiated into a lower and an upper layer of hairs.

21. *Pyrrosia sphaerosticha* (Mett.) Ching

- Pyrrosia sphaerosticha* (Mett.) Ching, Bull. Chin. Bot. Soc. 1 (1935) 62; Copel., Fern Fl. Philipp. (1960) 474; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 50; Hovenkamp, Leiden Bot. Ser. 9 (1986) 249. — [*Niphobolus sphaerostichus* J. Sm., J. Bot. (Hook.) 3 (1841) 396, nom. nud. — *Niphobolus smithianus* T. Moore, Index Filic. (1857) 76, nom. nud.] — *Sphaerostichum acrostichoides* C. Presl, Epim. Bot. (1851) 135. — *Polypodium sphaerosticha* Mett., Farngett. I. Polypodium (1856) 130, pl. 3, f. 13; Baker, Syn. Fil. (1867) 350; H. Christ, Ann. Jard. Bot. Buitenzorg 15 (1898) 165. — *Niphobolus sphaerostichus* C. Chr., Index Filic. (1906) 201; Alderw., Malayan Ferns (1908) 682; C. Chr., Leafl. Philipp. Bot. 9 (1933) 3256. — Type: *Cuming* 127 (PRC; B, BO, K, P), Luzon.
- Niphobolus sarasinorum* Giesenh., Niphobolus (1901) 162. — *Cyclophorus sarasinorum* C. Chr., Index Filic. (1906) 200; Alderw., Malayan Ferns (1908) 693; Malayan Ferns Suppl. (1917) 692. — Types: *Sarasin* 27, 1181 (P).
- Niphobolus warburgii* Giesenh., Niphobolus (1901) 163. — *Cyclophorus warburgii* C. Chr., Index Filic. (1906) 202; Alderw., Malayan Ferns (1908) 692. — Types: *Warburg s.n.*, 1888 (P); *Sarasin s.n.*, 1895 (P), Celebes.
- Cyclophorus pseudo-lingua* Alderw., Bull. Jard. Bot. Buitenzorg II, 8 (1913) 6; Malayan Ferns Suppl. (1917) 413. — Type: *Elmer* 9804 (A, B, BM, BO, K, L, M, P, U, US, Z), Negros.

Rhizome (1–)1.5–2.6 mm thick, long-creeping, phylloids 2–7 cm apart, buds half-way along the internodes. **Anatomy**: vascular strands 6–10, sclerenchyma sheath distinct, sclerenchyma strands c. 10, one central, the other peripheral. **Rhizome scales** spreading, peltate, 3.2–7.2 by 0.6–1.5 mm, base entire to dentate, acumen long-ciliate in the lower half, light brown, apex entire, crisped. **Fronds** dimorphic, stalked. Fertile fronds with stalks to 3–16 cm long, 0.3–1 × as long as the lamina, lamina 5–16 by 1–3 cm, index (2–)4–8, base cuneate to gradually attenuate, widest at or below the middle, apex obtuse to acuminate. Sterile fronds with stalks 1–14 cm, 0.1–1 × as long as the lamina, lamina 3.5–17 by 1.3–6 cm, index 2–4(–5), base cuneate to attenuate, apex obtuse or more or less rounded to long-acuminate. **Venation**: veins distinct, veinlets much branched and copiously anastomosing, free veinlets many, excurrent and recurrent. Hydathodes distinct. Stellate hairs monomorphic, appressed, forming a thin mat, light brown to whitish, the rays short, boat-shaped. **Sori** all over the lamina or in an irregular, sharply defined patch, very closely packed, superficial, developing more or less simultaneously, soral area appearing acrostichoid when old. Sporangia stalked, paraphyses not differentiated. Spores with irregular ridges and protuberances.

Distribution — *Malesia*: Sulawesi, Philippines, Moluccas (Bacan).

Habitat — Epiphytic, in forest or sometimes on exposed trees, occasionally epilithic. Altitude 200–2000 m.

22. *Pyrrosia splendens* (C. Presl) Ching

- Pyrrosia splendens* (C. Presl) Ching, Bull. Chin. Bot. Soc. 1 (1935) 68; Copel., Fern Fl. Philipp. (1960) 473; Holttum, Nov. Bot. Inst. Bot. Univ. Car. Prag. (1968) 27; Hovenkamp, Leiden Bot. Ser. 9 (1986) 251. — [*Niphobolus splendens* J. Sm., J. Bot. (Hook.) 3 (1841) 396, nom. nud.] — *Apalophlebia splendens* C. Presl, Epim. Bot. (1851) 138. — *Niphobolus splendens* T. Moore, Index Filic. (1858) 83; Giesenh., Niphobolus (1901) 99. — *Polypodium splendens* Hook., Sp. Fil. 5 (1864) 52, nom. illeg., non *P. splendens* Hook. l.c. 95. — *Polypodium nitens* Baker, Syn. Fil. (1867) 353, nom. illeg., non *P. nitens* Desv. — *Cyclophorus splendens* C. Chr., Index Filic. (1906) 201; Alderw., Malayan Ferns (1908) 696; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 16. — Type: *Cuming* 331 (PRC, teste Holttum l.c.; BM, K, P), Samar.

Rhizome 6–8 mm thick, not elongated, phyllopods contiguous. Anatomy: vascular strands c. 12, ground tissue completely sclerified. *Rhizome scales* spreading, basifixed, 4.7–7.8 mm long, entire, brown. *Fronde* monomorphic, sessile or indistinctly to 5 cm stalked, lamina 33–100 by 3.2–12.5 cm, index 8–14, base very gradually narrowed, widest above the middle, apex abruptly acuminate to apiculate. *Venation*: veins distinct, veinlets much branched and strongly anastomosing, free veinlets many, excurrent and recurrent. Hydathodes distinct. Stellate hairs dimorphic, a dense thin mat, light greyish brown, the straight upper rays dark brown, acicular, appressed with one central, elongated (to 2.5 mm), erect ray always present. *Sori* apical, closely packed in a sharply defined patch, 0.5 mm wide, containing c. 10 sporangia, many scattered over each areole, superficial, developing acropetally. Sporangia sessile, paraphyses not differentiated. Spores smooth.

Distribution — *Malesia*: Philippines.

Habitat — Mostly epiphytic, on trees near to or overhanging a river (very few data available). Altitude to 200 m (600 m according to Copeland 1960).

Note — Can only be confused with *P. princeps* and *P. platyphylla*, and easily distinguished by the long ‘dorsal spines’ on the stellate hairs.

23. *Pyrrosia stigmosa* (Sw.) Ching

Pyrrosia stigmosa (Sw.) Ching, Bull. Chin. Bot. Soc. 1 (1935) 67; Holttum, Revis. Fl. Malaya 2 (1955) 148; Hovenkamp, Leiden Bot. Ser. 9 (1986) 252. — *Polypodium stigmosum* Sw., J. Bot. (Schrader) 1800 (2) (1801) 21; Syn. Fil. (1806) 29, 226; Racib., Pterid. Buitenzorg (1898) 102. — *Niphobolus stigmosus* T. Moore, Index Filic. II (1861) 276; Giesenh., Niphobolus (1901) 113. — *Cyclophorus stigmosus* Desv., Mag. Ges. Naturf. Freunde Berlin 5 (1811) 301; C. Presl, Epim. Bot. (1851) 224; Alderw., Malayan Ferns (1908) 695; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 16; Backer & Posth., Varenfl. Java (1939) 242; Dickason, Ohio J. Sc. 46 (1946) 129. — Type: *Thunberg s.n.* (S, n.v.), Java.

Niphobolus venosus Blume, Fl. Javae Fil. (1829) 63, pl. 28 a-d; C. Presl, Tent. Pterid. (1836) 202. — *Apalophlebia venosa* C. Presl, Epim. Bot. (1851) 139. — Type: *Zippelius s.n.* (L), Java.

Rhizome 4–4.5 mm thick, shortly elongated, phyllopods 1–2 cm apart, buds at the base of the phyllopods. Anatomy: vascular strands 7–13, ground tissue completely sclerified. *Rhizome scales* spreading, basifixed, 2.6–6 by 0.9–1.6 mm, dentate or with entire acumen, brown. *Fronde* monomorphic, stalked, stalk 3–24(–37) cm, 0.2–0.7 × as long as the lamina, lamina 11–48 by 1.5–5.2 cm, index 4–13, base cuneate, widest near the middle, apex acute to acuminate, occasionally rounded or obtuse. *Venation*: veins distinct, veinlets much branched and strongly anastomosing, free veinlets many, excurrent and recurrent. Hydathodes distinct. Stellate hairs dimorphic, a dense mat, light greyish brown, the straight upper rays boat-shaped, appressed. *Sori* apical to all over the lamina, shortly spaced, in an ill-defined patch, 0.5 mm wide, containing c. 10 sporangia, many scattered over each areole, superficial, developing acropetally. Sporangia sessile, paraphyses not differentiated. Spores smooth.

Distribution — Indochina to Sulawesi. *Malesia*: Sumatra, Peninsular Malaya, Java, Lesser Sunda Islands (Bali), Sulawesi (South).

Habitat — Epilithic, in forest or on open places, often on limestone, also epiphytic, in forest or on wayside trees. Altitude from sea level to 1500 m.

SELLIGUEA

(P. H. Hovenkamp)

- Selliguea* Bory, Dict. class. d'Hist. Nat. (1825) pl. 41; Blume, Enum. Pl. Javae (1828), Addenda et emendanda; C. Presl, Epim. Bot. (1851) 145; J. Sm., Hist. Fil. (1875) 101; Ching, Sunyatsenia 5 (1940) 260; Copel., Gen. Fil. (1947) 209; Holttum, Revis. Fl. Malaya 2 (1954) 156; Copel., Fern Fl. Philipp. (1960) 507; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. (1990) 214. — Type species: *Selliguea feei* Bory.
- Crypsinus* C. Presl, Epim. Bot. (1851) 123; Copel., Gen. Fil. (1947) 205; Holttum, Revis. Fl. Malaya 2 (1954) 193 f. 96–103; Copel., Fern Fl. Philipp. (1960) 500; Ching, Acta Phytotax. Sin. 9 (1964) 181. — Type species: *Crypsinus nummularius* C. Presl (nom. superfl. for *Polypodium pyrolaefolium* Goldm. = *Selliguea pyrolifolia*).
- Holcosorus* T. Moore, Index Filic. (1857) 29; Ching, Sunyatsenia 5 (1940) 265; Copel., Gen. Fil. (1947) 208. — Type species: *Grammitis bisulcata* Hook. (= *Selliguea bisulcata*).
- Phymatopsis* J. Sm., Hist. Fil. (1875) 104; H. Itô, J. Jap. Bot. 9 (1935) 98; Ching, Acta Phytotax. Sin. 9 (1964) 181, nom. illeg., non Trevisan. — *Phymatopteris* Pichi Serm., Webbia 28 (1973) 460. — Type species: *Polypodium palmatum* Blume (= *Selliguea taeniata*).
- Grammatopteris* Alderw., Bull. Jard. Bot. Buitenzorg III, 4 (1922) 317, pl. 15, nom. illeg., non Renault (1892), fossil. — *Grammatopteridium* Alderw., Nova Guinea 16 (1924) 24; C. Chr., Dansk Bot. Ark. 6 (1929) 80, pl. 8, f. 7; pl. 11, f. 1; Ching, Sunyatsenia 5 (1940) 261; Copel., Gen. Fil. (1947) 208. — Type species: *Grammatopteridium brooksii* (Alderw.) Copel. (= *Selliguea brooksii*).
- Pycnoloma* subg. *Eupycnoloma* C. Chr., Dansk Bot. Ark. 6 (1929) 75, pl. 8, f. 1–2; pl. 9, f. 2; pl. 10, f. 1, 1. — *Pycnoloma* Holttum, Revis. Fl. Malaya 2 (1954) 207, f. 109; Ching, Sunyatsenia 5 (1940) 261; Copel., Gen. Fil. (1947) 207. — Type species: *Pycnoloma rigidum* (Hook.) C. Chr. (= *Selliguea rigida*).
- Pycnoloma* subg. *Pleuripteris* C. Chr., Dansk Bot. Ark. 6 (1929) 76, pl. 8, f. 4–6, pl. 10, f. 4. — Type species: *Pycnoloma murudense* C. Chr. (= *Selliguea murudensis*).
- Oleandropsis* Copel., Univ. Calif. Publ. Bot. 18 (1942) 226; Gen. Fil. (1947) 208. — Type species: *Oleandropsis ferrea* (Brause) Copel. (= *Selliguea ferrea*).
- Crypsinopsis* Pichi Serm., Webbia 31 (1977) 240. — Type species: *Polypodium triquetrum* Blume (= *Selliguea triquetra*).

Epiphytic, epilithic or terrestrial, small to medium-sized ferns. *Rhizome* creeping, short to long-trailing, slightly to strongly glaucous, densely set with persistent or occasionally deciduous scales, in cross section with 0–many sclerenchyma strands. *Rhizome scales* basifixed, pseudopeltate to peltate, appressed to squarrose. *Fronde* monomorphic or dimorphic, more or less distinctly differentiated in stipe and lamina. Lamina simple, pinnatifid to pinnate, the fertile parts usually narrowed, texture thin to thick-leathery, sparsely set with inconspicuous short glandular hairs on both sides, upper surface often with hydathodes; margin often with a thickened, cartilaginous border, rarely with a flat, wide, cartilaginous border, with or without notches. *Venation*: at least one row of closed areoles present, usually with excurrent and recurrent included free veinlets, free veinlets rarely only excurrent, or absent; margin with few to many excurrent free veinlets. Anatomy: stomata on abaxial surface only, polo- and copolocytic, a distinct hypodermis present on adaxial side, frequently on abaxial side as well. *Sori* 1–5 mm wide in smallest diameter, round or elongated, superficial to deeply sunken in pits forming distinct pustules on the adaxial surface, 1 or 2 (rarely more) in each areole, in one to many rows between midrib and margin, in the latter case forming distinct single or double rows between the adjacent veins, sometimes

forming many transverse coenosori, sometimes in single longitudinal coenosori. Sporangia stalked, glabrous, intermixed with highly variable numbers of uniseriate paraphyses. Spores brown, monolete, bilateral, smooth to colliculate, dotted with spines or globules in varying densities. — **Fig. 28–30.**

Distribution — From India to Japan, throughout *Malesia*, extending to Australia (Queensland) and Fiji.

Taxonomy — Many genera are here included in *Selliguea* which have persistently been treated as separate. None of these correspond to any of the natural groups that can be distinguished within *Selliguea*.

Crypsinus, circumscribed by simple fronds, small, separate sori in a single row and indistinct main veins, contains a number of species that obviously are reduced forms of species of other genera.

Selliguea is recognised by the large, usually confluent sori in one row between the veins. Its core species is *S. feei*, and it would have to include all species obviously related to *S. feei*, several of which are often classified as *Crypsinus*, *Grammatopteridium* or *Oleandropsis*.

Crypsinopsis, with sori in two rows between the adjacent veins, contains in this circumscription the species related to *Selliguea enervis*. However, small, reduced species would have to be included in *Crypsinus*, and in many cases their affinity to *S. enervis* is doubtful.

Phymatopteris is usually interpreted to include all species with pinnate fronds, as well as the simple-fronded species which are obviously related. Some of these, including its type species, *C. pyrolifolius*, have been included in *Crypsinus*. On the other hand, within the apparently natural group of pinnate species there is a considerably variability. There are much more differences between *Selliguea (Phymatopteris) taeniata* and *S. (P.) albidosquamata* than between the genera *Crypsinus* and *Crypsinopsis*; and *S. (P.) triloba* is in many ways more similar to *S. feei* (e.g., in the scales of the rhizome and the texture and anatomy of the sterile lamina) than to *S. taeniata*.

Pycnoloma and *Grammatopteridium* include the 'drymoglossoid' representatives of this group of ferns. Christensen (1929) already noted that *Pycnoloma* probably is an heterogeneous assemblage derived from several origins in either *Crypsinus* or *Phymatopsis (Phymatopteris)*. All species included in *Pycnoloma* are small and reduced, and have no characters clearly indicating their affinity. *Grammatopteridium* differs from *Pycnoloma* in larger fronds and more complex venation (Christensen l.c.), and clearly is a dimorphic modification of a *Selliguea*. Christensen's inclusion of *S. brooksii* under *S. (Grammatopteridium) costulata* demonstrates that it is hardly possible to distinguish clearly between the drymoglossoid derivatives of *S. feei* and those of other species of *Selliguea*.

Holcosorus includes all forms with narrow, gramineous fronds. Apart from *Selliguea (H.) setacea* and *S. (H.) bisulcata*, this includes forms which can be assigned to several other species of *Selliguea*.

There are several possibly natural groups that can be recognised in *Selliguea*, but also a large number of species of uncertain affinity. *Selliguea feei* is the central species in a relatively clear-cut group comprising *S. albicaula*, *S. archboldii*, *S. belli-*

squamata, *S. costulata*, *S. cretifera*, *S. decockii*, *S. elmeri*, *S. feei*, *S. ferrea*, *S. lauterbachii*, *S. plantaginea*; and *S. tafana* (see the notes under 17. *S. feei* and 32. *S. plantaginea*). Their main characteristics are the relatively thick coenosori, the presence of distinct hypodermises below the upper epidermis, and sometimes also the lower epidermis, the long-creeping rhizome with a thick sclerified sheath around the vascular bundles.

Selliguea enervis is, likewise, a central species in a group comprising also *S. gracillipes*, *S. hellwigii*, *S. pampolycarpa*, *S. stenosquamis* and *S. subsparsa*. These are characterised mainly by smallish, round sori in two rows between the veins, a more shortly creeping rhizome without sclerification around the vascular bundles. Whether *S. triqueira* also belongs in this group is uncertain, as it shares some characters with the group of *S. feei*.

Selliguea heterocarpa and *S. lateritia* form a distinct group, to which probably *S. craspedosora* and possibly *S. setacea* also belong, with sunken coenosori as the main distinguishing character.

Selliguea soridens and *S. stenophylla* form the only group that also appears to be distinct in spore morphology: in contrast to most other species, their spores have a strongly sculptured surface without globular appendages. Otherwise, this group is recognisable by the deeply sunken, round sori in a single row near the margin.

The pinnate-pinnatifid species, with the exception of *S. albidosquamata* and *S. triloba*, form a natural group characterised by the single sori in each main areole. To this group also belong *S. pyrolifolia* and *S. whitfordii*. Most of the species of *Selliguea* from Continental Asia also belong to this group (*Phymatopteris* of most authors), as well as *S. simplicissima*, from Queensland. *Selliguea albidosquamata* is too aberrant to include it in this group, sharing several characters with the equally isolated *S. platyphylla*. *Selliguea triloba* shares a number of characters with *S. feei* and *S. heterocarpa*, which makes its position in any of the groups aberrant.

Affinities of *Selliguea* are with the drynarioid ferns on the one hand, with *Polypodium* (not in Malesia) on the other. With the drynarioid ferns *Selliguea* shares the peculiar thick lamina texture of many species (with corresponding similarities in lamina anatomy, such as the presence of a distinct hypodermis below the upper surface), the non-clathrate scales, and a number of correspondences in spore-wall sculpture. There are no specific characters that distinguish *Selliguea* from a putative common ancestor with the drynarioid ferns, and it therefore cannot be excluded that this genus is unnatural. Smaller genera in this alliance are *Arthromeris*, *Paraselliguea*, and possibly *Polypodiopteris*.

KEY TO THE SPECIES

- | | |
|---|----|
| 1a. Fronds pinnatifid to pinnate | 65 |
| b. Fronds simple | 2 |
| 2a. Fertile parts much narrower than sterile parts | 3 |
| b. Fertile parts similar to sterile part or somewhat narrower, or all fronds equally narrow, gramineous | 25 |
| 3a. Coenosori present | 4 |
| b. Sori round, elongate or confluent, not forming continuous coenosori | 11 |

- 4a. Coenosori transverse (sori confluent across connecting veins) **22. S. heterocarpa**
 b. Coenosori longitudinal (sori confluent across veins) 5
- 5a. Rhizome scales acute, sori superficial 6
 b. Rhizome scales contracted to a narrow acumen, sori deeply sunken **36. S. rigida**
- 6a. Rhizome scales pseudopeltate, margin of sterile fronds without notches **27. S. metacoela**
 b. Rhizome scales peltate, margin of sterile fronds with notches sporadically to regularly present 7
- 7a. Vascular strands in the rhizome without fully sclerified bundle sheath 8
 b. Vascular strands in the rhizome with fully sclerified bundle sheath, sometimes 2 cells thick 9
- 8a. Sclerenchyma strands in the rhizome mainly central, hydathodes present, sometimes infrequent **28. S. murudensis**
 b. Sclerenchyma strands in rhizome scattered, hydathodes absent **8. S. brooksii**
- 9a. Rhizome radial (at least in parts), sterile fronds narrow, 0.1–0.3 cm wide, index 6–18, sclerenchyma strands absent to many **18. S. ferrea**
 b. Rhizome completely dorsiventral, sterile fronds mostly over 0.3 cm wide, index 2–7, sclerenchyma strands very many 10
- 10a. Rhizome not sclerified, rhizome scales narrow, 1–1.5 mm wide, remotely and weakly to strongly dentate **11. S. costulata**
 b. Rhizome with subperipheral sclerified sheath, rhizome scales wide, 1.8–3 mm wide, with a flabelloid, irregular margin **14. S. dekockii**
- 11a. Sori deeply sunken 12
 b. Sori superficial or slightly sunken 13
- 12a. Rhizome scales elongated, 4.8–9 long, acute to acuminate, evenly brown; vascular strands in the rhizome 4; costa only distinct **38. S. soridens**
 b. Rhizome scales short, 3.8–4 mm long, obtuse to acute, with a distinct light margin; vascular strands in the rhizome 11–14; at least the veins distinct (simple forms) **46. S. triloba**
- 13a. Vascular strands in the rhizome with fully sclerified bundle sheath, sometimes 2 cells thick 14
 b. Vascular strands in the rhizome without fully sclerified bundle sheath 18
- 14a. Sori in 2–4 rows between costa and margin (form from Sulawesi) **9. S. caudiformis**
 b. Sori in one row between costa and margin 15
- 15a. Rhizome scales wide, 1.8–3 mm wide, margin entire, irregularly flabelloid, the ground tissue of rhizome with subperipheral sclerified sheath **14. S. dekockii**
 b. Rhizome scales narrower, to 1.5 mm wide, margin dentate, ground tissue of rhizome not sclerified 16
- 16a. Fertile fronds shorter than sterile ones, sori large, spreading over the areole, covered with persistent scales, rhizome scales short-dentate ... **45. S. tafana**
 b. Fertile fronds usually longer than sterile ones, sori smaller, not spreading over the entire areole, without persistent scales, rhizome scales strongly dentate or long-ciliate 17

- 17a. Notches in fertile fronds absent, rhizome little elongated, internodes 0.5–2 cm long **5. *S. bakeri***
- b. Notches in fertile fronds regularly present, rhizome elongated, internodes 2.5–3 cm long **26. *S. lauterbachii***
- 18a. Sclerenchyma strands in the rhizome few 19
- b. Sclerenchyma strands in the rhizome many to very many 21
- 19a. Sori in two or more rows between costa and margin, in two rows between adjacent veins **16. *S. enervis***
- b. Sori in one row between costa and margin, single between adjacent veins . 20
- 20a. Fertile fronds narrow, to 0.3 cm **35. *S. pyrolifolia***
- b. Fertile fronds wider, 0.6–1.6 cm **49. *S. whitfordii***
- 21a. Sori often longitudinally elongate or confluent into a coenosorus 22
- b. Sori round, not elongate or confluent 24
- 22a. Rhizome scales strongly dentate, sclerenchyma strands in the rhizome scattered, sori large, elongate, all separate **5. *S. bakeri***
- b. Rhizome scales remotely and weakly dentate to short-dentate, sclerenchyma strands in the rhizome mainly central, sori small, separate, confluent or forming an interrupted coenosorus 23
- 23a. Lamina of fertile fronds 2–3 mm wide, sori often crossing the veins **28. *S. murudensis***
- b. Lamina of fertile fronds 3–6 mm wide, sori separate or elongate, but not confluent across the veins **34. *S. pseudoacrostichum***
- 24a. Hydathodes absent, rhizome scales strongly dentate **42. *S. subsparsa***
- b. Hydathodes frequent, rhizome scales remotely and weakly to short-dentate (form from Borneo: ‘kamborangana’) **16. *S. enervis***
- 25a. Hydathodes absent or infrequent 39
- b. Hydathodes frequent 26
- 26a. Margin of sterile fronds: notches frequent 27
- b. Margin of sterile fronds: notches absent or infrequent 34
- 27a. Rhizome less than 1 mm thick, wiry 28
- b. Rhizome over 2 mm thick, stout 29
- 28a. Fertile parts narrowed, sclerenchyma strands in the rhizome few **21. *S. hellwigii***
- b. Fertile parts similar to sterile part, sclerenchyma strands in the rhizome absent **30. *S. oodes***
- 29a. Sori in two, sometimes more rows between adjacent veins 30
- b. Sori in one row between adjacent veins 31
- 30a. Sori in 5 or more rows between costa and margin, with a slight but distinct rim around the receptacle, vascular strands in rhizome with fully sclerified bundle sheath, sclerenchyma strands absent **2. *S. albidopaleata***
- b. Sori in 1–4 rows between costa and margin, without rim around the receptacle, vascular strands in rhizome without fully sclerified bundle sheath, sclerenchyma strands many (some unusual forms from Sulawesi and New Guinea) **16. *S. enervis***
- 31a. Rhizome scales obtuse (an often trilobed form from Flores) **17. *S. feei***
- b. Rhizome scales acute or contracted to a narrow acumen 32

- 32a. Sori in 5 or more rows between costa and margin 33
 b. Sori in one row between costa and margin (simple forms) **44. *S. taeniata***
- 33a. Sori deeply sunken, hydathodes with conspicuous, persistent calcareous scales, rhizome scales contracted to a narrow, ciliate acumen, margin very strongly thickened, notches in fertile fronds regularly present **33. *S. platyphylla***
 b. Sori superficial or slightly sunken, hydathodes without persistent calcareous scales, rhizome scales acute, entire or remotely and weakly dentate, fertile parts narrowed, margin not very strongly thickened, notches in fertile fronds absent or sporadically present (form from Seram) **9. *S. caudiformis***
- 34a. Sori in two, rarely more rows between adjacent veins 35
 b. Sori in one row between adjacent veins 36
- 35a. Rhizome scales usually appressed, 2–3 mm wide, entire **47. *S. triquetra***
 b. Rhizome scales usually spreading, narrow, to 1 mm wide, dentate **16. *S. enervis***
- 36a. Vascular strands in the rhizome without fully sclerified bundle sheath 37
 b. Vascular strands in the rhizome with fully sclerified bundle sheath, sometimes 2 cells thick 38
- 37a. Rhizome scales remotely and weakly dentate, sori confluent or forming sometimes interrupted coenosori, hydathodes without persistent calcareous scales **22. *S. heterocarpa***
 b. Rhizome scales strongly dentate or long-ciliate, sori round, hydathodes with persistent calcareous scales (simple forms) **3. *S. albidosquamata***
- 38a. Coenosori usually long, sometimes interrupted (typical form) **17. *S. feei***
 b. Sori separate, (occasionally) confluent or in short coenosori, often a single row of sori along the costa slightly separate from the others (form from Philippines and Ternate) **9. *S. caudiformis***
- 39a. Sori singly or in one row between adjacent veins (if indistinct follow this lead) 40
 b. Sori distinctly in two or more rows between adjacent veins 54
- 40a. Rhizome scales obtuse, usually appressed 41
 b. Rhizome scales acute or contracted to a narrow acumen 42
- 41a. Rhizome scales bicolorous, with a central or apical dark spot, not adhering to each other, sparsely set (most conspicuously on older parts of the rhizome), with distinctly cucullate apex (New Guinea) **32. *S. plantaginea***
 b. Rhizome scales concolorous or nearly so, strongly overlapping and completely covering the rhizome, often with the margins strongly adhering to each other (forms from Sulawesi and the Moluccas) **6. *S. bellisquamata***
- 42a. Sori deeply sunken 43
 b. Sori superficial or slightly sunken 45
- 43a. Sori in two or more rows between costa and margin, veins distinct **25. *S. lateritia***
 b. Sori in one row between costa and margin, costa only distinct 44
- 44a. Fertile parts narrowed, notches in fertile fronds regularly present **38. *S. soridens***
 b. Fertile parts similar to sterile part, notches absent or sporadically present **40. *S. stenophylla***

- 45a. Fronds gramineous, less than 2 mm wide (gramineous form from New Guinea) **16. *S. enervis***
- b. Fronds not gramineous, over 3 mm wide 46
- 46a. Vascular strands in the rhizome without fully sclerified bundle sheath 47
- b. Vascular strands in the rhizome with fully sclerified bundle sheath, often 2 cells thick 50
- 47a. Rhizome scales contracted to a narrow subulate acumen, notches absent from lamina margin 48
- b. Rhizome scales acute, notches sporadically or regularly present on lamina margin 49
- 48a. Sori in two or more rows between costa and margin or in, usually interrupted, coenosori, veins distinct **25. *S. lateritia***
- b. Sori in one row between costa and margin, close to the margin, costa only distinct **12. *S. craspedosora***
- 49a. Medium-sized plants, lamina of fertile fronds 14–22 cm long, veins distinct, sori in 2–4 rows between costa and margin, rhizome scales very large, pseudopeltate **39. *S. sri-ratu***
- b. Small plants, lamina of fertile fronds 2.5 to 7 cm long, costa only distinct, sori in one row between costa and margin, rhizome scales small, peltate **29. *S. neglecta***
- 50a. Rhizome scales appressed (Luzon) **15. *S. elmeri***
- b. Rhizome scales spreading or squarrose 51
- 51a. Rhizome scales narrowly acuminate to subulate, squarrose 52
- b. Rhizome scales obtuse to acute, not squarrose 53
- 52a. Fertile fronds narrow, to 1 cm wide, index 13–14, rhizome scales sparsely set and not fully covering the glaucous rhizome **1. *S. albicaula***
- b. Fertile fronds to 1.4 cm wide, index c. 10, rhizome scales dense, covering the rhizome **4. *S. archboldii***
- 53a. Sori in two or more rows between costa and margin **32. *S. plantaginea***
- b. Sori in one row between costa and margin **13. *S. cretifera***
- 54a. Sori in one row between costa and margin 55
- b. Sori in two or more rows between costa and margin 61
- 55a. Margin of fronds without notches, rhizome scales contracted to a subulate apex 56
- b. Margin of fronds with notches sporadically to regularly present, rhizome scales acute, apex not subulate 58
- 56a. Sterile fronds 0.6–1 cm wide, fertile parts narrowed, rhizome scales evenly coloured **12. *S. craspedosora***
- b. All fronds equally narrow, gramineous 57
- 57a. Rhizome short, internodes not elongated, scales pseudopeltate . **37. *S. setacea***
- b. Rhizome slightly elongated, internodes to 0.5 cm, scales peltate **7. *S. bisulcata***
- 58a. Rhizome scales pseudopeltate, internodes not elongated (narrow forms) **10. *S. ceratophylla***
- b. Rhizome scales peltate, internodes distinctly elongated 59
- 59a. Margin cartilaginous, strongly thickened (New Guinea) **20. *S. gracilipes***
- b. Margin not differentiated, or cartilaginous, but not strongly thickened 60

- 60a. Rhizome scales entire to short-dentate **16. *S. enervis***
 - b. Rhizome scales strongly dentate **42. *S. subsparsa***
- 61a. Lamina very gradually narrowed into the stipe, more or less spatulate, widest at or above the middle 62
 - b. Lamina distinct from the stipe, mostly lanceolate, widest at or below the middle 63
- 62a. Rhizome scales peltate, costa with two distinct, narrow ridges on upper surface **31. *S. pampolycarpa***
 - b. Rhizome scales pseudopeltate, costa flat or with low ridges on upper surface **10. *S. ceratophylla***
- 63a. Rhizome scales strongly dentate (Sumatra, some forms of *S. enervis* from New Guinea may also key out here) **42. *S. subsparsa***
 - b. Rhizome scales entire to short-dentate 64
- 64a. Rhizome scales not squarrose, acute **16. *S. enervis***
 - b. Rhizome scales squarrose, contracted to a narrow acumen **41. *S. stenosquamis***
- 65a. Fertile parts strongly contracted 66
 - b. Fertile parts similar to sterile part or slightly narrowed 67
- 66a. Fronds dimorphic, simple to pinnatifid, sori deeply sunken, hydathodes absent or infrequent **46. *S. triloba***
 - b. Fronds internally dimorphic, pinnate, sori superficial, hydathodes frequent ... **24. *S. lagunensis***
- 67a. Hydathodes with persistent calcareous scales **3. *S. albidosquamata***
 - b. Hydathodes without persistent calcareous scales 68
- 68a. Fronds pinnate 69
 - b. Fronds pinnatifid 71
- 69a. Lowermost pinnae not transversely inserted, vascular strands in the rhizome without sclerified bundle sheath, rhizome scales various but not shining .. 70
 - b. Lowermost pinnae transversely inserted, vascular strands in the rhizome with strongly developed sclerenchyma sheath, rhizome scales shining brown ... **48. *S. violascens***
- 70a. Rhizome scales entire or weakly dentate, basal pinnae not cut out to costa at basiscopic base, veins on upper surface not raised **44. *S. taeniata***
 - b. Rhizome scales strongly dentate at least at base, basal pinnae cut out to costa at basiscopic base, veins on upper surface raised **43. *S. subtaeniata***
- 71a. Rhizome scales 9–17 mm long, thick, brittle, brown to blackish, entire, lower surface of lamina usually very distinctly glaucous (Philippines) **19. *S. glauca***
 - b. Rhizome scales smaller, thin, not brittle, lower surface of lamina not or slightly glaucous 72
- 72a. Sclerenchyma strands in the rhizome mainly peripheral, rhizome scales strongly dentate, veins on upper surface raised, sori slightly or deeply sunken **23. *S. laciniata***
 - b. Sclerenchyma strands in the rhizome scattered or mainly central, rhizome scales entire to short-dentate, veins on upper surface not raised, sori superficial **44. *S. taeniata***

KEY TO THE SPECIES OF SUMATRA, PENINSULAR MALAYSIA, JAVA
AND THE LESSER SUNDA ISLANDS

- 1a. Fertile parts strongly contracted 2
- b. Fertile parts similar to sterile part or narrowed 10
- 2a. Rhizome scales with a narrow, subulate, entire acumen . **12. *S. craspedosora***
- b. Rhizome scales with acumen not narrow, subulate 3
- 3a. Sori slightly or deeply sunken 4
- b. Sori superficial 6
- 4a. Rhizome scales strongly dentate, sori round or longitudinally elongate **5. *S. bakeri***
- b. Rhizome scales entire to short-dentate, sori round or forming transverse coenosori 5
- 5a. Hydathodes absent, margin of sterile fronds with notches sporadically to regularly present, sori round **46. *S. triloba***
- b. Hydathodes frequent, margin of sterile fronds without notches, sori in transverse coenosori **22. *S. heterocarpa***
- 6a. Sori round or elongated, not forming coenosori crossing the veins 7
- b. Sori forming long, sometimes interrupted coenosori, usually across the veins 8
- 7a. Rhizome scales remotely and weakly dentate, hydathodes constantly present, notches in fertile fronds sporadically present **34. *S. pseudoacrostichum***
- b. Rhizome scales strongly dentate, hydathodes absent or occasionally present, notches in fertile fronds absent **5. *S. bakeri***
- 8a. Rhizome scales pseudopeltate, sclerenchyma strands in the rhizome few, costa only distinct **27. *S. metacoela***
- b. Rhizome scales peltate, sclerenchyma strands in the rhizome many, veins distinct 9
- 9a. Upper surface of lamina not glandular **28. *S. murudensis***
- b. Upper surfaces of lamina distinctly glandular **8. *S. brooksii***
- 10a. Fronds pinnatifid or pinnate 11
- b. Fronds simple or trilobed 15
- 11a. Fronds pinnatifid **23. *S. laciniata***
- b. Fronds fully pinnate 12
- 12a. Calcareous scales persistent, margin of fronds without notches **3. *S. albidosquamata***
- b. Calcareous scales not persistent, notches regularly present 13
- 13a. Pinnae inserted more or less transverse to the rachis, rhizome with few, inconspicuous sclerenchyma strands, scales shiny **47. *S. violascens***
- b. Pinnae in the same plane with the rachis, rhizome with many sclerenchyma strands, rhizome scales dull 14
- 14a. Rhizome scales strongly dentate at least at their base, basal pinnae cut to midrib on basiscopic side **43. *S. subtaeniata***
- b. Rhizome scales entire or weakly dentate, basal pinnae with equal base or cut to midrib on acroscopic side **44. *S. taeniata***
- 15a. Sori in two or more rows between adjacent veins 16
- b. Sori in one row between adjacent veins 22

- 16a. Hydathodes frequent 17
 b. Hydathodes absent 18
- 17a. Rhizome scales entire, internodes to 2.5 cm long **47. *S. triquetra***
 b. Rhizome scales short-dentate to strongly dentate, internodes to c. 1 cm long ...
 **16. *S. enervis***
- 18a. Rhizome scales pseudopeltate, rhizome short, phyllopods mostly nearly contiguous **10. *S. ceratophylla***
 b. Rhizome scales peltate, rhizome short=creeping, phyllopods distinctly spaced ..
 **42. *S. subsparsa***
- 19a. Sori sunken 20
 b. Sori superficial 23
- 20a. Sori confluent, often forming transverse coenosori 21
 b. Sori round 22
- 21a. Hydathodes absent, rhizome scales with narrow subulate acumen
 **25. *S. lateritia***
 b. Hydathodes frequent, rhizome scales with wide, flat acumen
 **22. *S. heterocarpa***
- 22a. Sori in 5 or more rows between midrib and margin **33. *S. platyphylla***
 b. Sori in one row between midrib and margin **40. *S. stenophylla***
- 23a. Rhizome scales strongly dentate, costa only distinct, hydathodes absent, sori round **29. *S. neglecta***
 b. Rhizome scales entire or remotely and weakly dentate, veins distinct, hydathodes frequent, sori in transverse coenosori **17. *S. feei***

KEY TO THE SPECIES OF BORNEO

- 1a. Fertile parts strongly contracted, much narrower than fertile parts 2
 b. Fertile parts similar to sterile part, slightly narrowed or both equally narrow, gramineous 8
- 2a. Sori superficial 3
 b. Sori sunken 5
- 3a. Margin of sterile fronds without notches, rhizome scales pseudopeltate, hydathodes absent, costa only distinct **27. *S. metacoela***
 b. Margin of sterile fronds with notches regularly present, rhizome scales peltate, hydathodes sometimes present, or frequent, at least veins distinct 4
- 4a. Sori round, sterile lamina 10.5 cm long, notches in fertile fronds regularly present ('kamborangana') **16. *S. enervis***
 b. Sori elongate, forming coenosori, sterile lamina 2–5.5 cm long, notches in fertile fronds absent **28. *S. murudensis***
- 5a. Sori forming longitudinal coenosori **36. *S. rigida***
 b. Sori separate or in transverse coenosori 6
- 6a. Hydathodes frequent, margin of sterile fronds without notches
 **22. *S. heterocarpa***
 b. Hydathodes absent, margin of sterile fronds with notches sporadically to regularly present 7

- 7a. Rhizome with 11–14 vascular strands, rhizome scales with a lighter margin, at least veins distinct **46. *S. triloba***
- b. Rhizome with 4 vascular strands, rhizome scales evenly coloured, costa only distinct **38. *S. soridens***
- 8a. Hydathodes frequent 9
- b. Hydathodes absent or infrequent 15
- 9a. Fertile fronds trilobed, pinnatifid or pinnate 10
- b. Fronds simple 11
- 10a. Hydathodes covered with persistent calcareous scales, rhizome scales peltate, strongly dentate or ciliate, margin without notches **3. *S. albidosquamata***
- b. Hydathodes without persistent calcareous scales, rhizome scales pseudopeltate, entire to short-dentate margin with notches **44. *S. taeniata***
- 11a. Lamina margin flat, translucent, with notches near apex only, rhizome with fully sclerified sheaths around the vascular strands **2. *S. albidopaleata***
- b. Lamina margin not differentiated or thickened, notches if present not only near apex, vascular strands without or with incompletely sclerified sheath 12
- 12a. Rhizome scales long-ciliate, lamina margin cartilaginous, strongly thickened, hydathodes with persistent calcareous scales **33. *S. platyphylla***
- b. Rhizome scales entire to short-dentate, lamina margin not strongly thickened, hydathodes without persistent calcareous scales 13
- 13a. Fertile parts similar to sterile part, lamina 1.5–8 cm long, costa only distinct, lamina margin with notches **30. *S. oodes***
- b. Fertile parts narrowed, lamina 12–52 cm long, veins distinct, lamina margin without notches or with notches sporadically present, absent from fertile fronds 14
- 14a. Sori in one row between adjacent veins, often forming transverse coenosori, deeply sunken **22. *S. heterocarpa***
- b. Sori in two rows between adjacent veins, not forming transverse coenosori, superficial **16. *S. enervis***
- 15a. Sori in two or more rows between midrib and margin between midrib and margin 16
- b. Sori in one row between midrib and margin 20
- 16a. Sori in one row between adjacent veins, often forming transverse coenosori, rhizome scales with narrow, entire, subulate apex 17
- b. Sori in two rows between adjacent veins, not forming transverse coenosori, rhizome scales not with subulate apex 18
- 17a. Rhizome scales 1.2–2.5 mm wide in the acumen, strongly dentate **39. *S. sri-ratu***
- b. Rhizome scales with narrow, subulate, entire acumen **25. *S. lateritia***
- 18a. Rhizome short, with phyllopods nearly contiguous, rhizome scales pseudopeltate **10. *S. ceratophylla***
- b. Rhizome shortly elongated, phyllopods usually distinctly spaced, rhizome scales peltate 19
- 19a. Lamina margin without or with few notches, fronds monomorphic to weakly dimorphic **16. *S. enervis***
- b. Lamina margin regularly with notches, fronds weakly to strongly dimorphic ... **42. *S. subsparsa***

- 20a. Rhizome scales with narrow, subulate acumen, fronds gramineous, less than 2 mm wide 21
 b. Rhizome scales with acumen not subulate, fronds usually not gramineous, over 2 mm wide 22
 21a. Rhizome shortly elongated, phyllopods distinctly (0.5 cm) spaced, fronds quadrangular in cross section **7. *S. bisulcata***
 b. Rhizome short, phyllopods contiguous, fronds not quadrangular in cross section. **37. *S. setacea***
 22a. Sori deeply sunken 23
 b. Sori superficial or slightly sunken **42. *S. subsparsa***
 23a. Fertile parts similar to sterile part, margin without notches or notches sporadically present **40. *S. stenophylla***
 b. Fertile parts narrowed, margin of fronds with notches regularly present **38. *S. soridens***

KEY TO THE SPECIES OF THE PHILIPPINES

- 1a. Fertile fronds trilobed, pinnatifid or fully pinnate 2
 b. Fertile fronds simple 6
 2a. Rhizome scales pseudopeltate **44. *S. taeniata***
 b. Rhizome scales peltate 3
 3a. Rhizome scales strongly dentate, or long-ciliate, hydathodes with persistent calcareous scales, margin of the sterile fronds without notches **3. *S. albidosquamata***
 b. Rhizome scales entire to short-dentate, hydathodes, if present, without persistent calcareous scales, margin of all fronds notched 4
 4a. Fertile fronds pinnatifid, glaucous, fertile parts similar to sterile part, rhizome scales dark, shiny, evenly coloured **19. *S. glauca***
 b. Fertile fronds fully pinnate, not glaucous, fertile parts strongly contracted, rhizome scales with a lighter margin 5
 5a. Sterile fronds normally absent, most fronds with narrowed apical fertile parts, pinnae ovate, narrowed at the base, sori superficial **24. *S. lagunensis***
 b. Sterile fronds regularly present, fertile fronds with narrowed lamina, pinnae linear, not narrowed at the base, sori deeply sunken **46. *S. triloba***
 6a. Hydathodes absent 7
 b. Hydathodes frequent 10
 7a. Fertile parts strongly contracted, sori deeply sunken **46. *S. triloba***
 b. Fertile parts narrowed, sori superficial or shallowly sunken 8
 8a. Sori in two rows between adjacent veins, notches in fertile fronds regularly present **16. *S. enervis***
 b. Sori in one row between adjacent veins, notches in fertile fronds absent or sporadically present 9
 9a. Sori sunken, rhizome scales spreading or squarrose, contracted to a narrow subulate acumen, margin of sterile fronds without notches **25. *S. lateritia***
 b. Sori superficial, rhizome scales appressed, acute, margin of sterile fronds with notches regularly present **15. *S. elmeri***

- 10a. Sclerenchyma strands many 11
- b. Sclerenchyma strands absent or few 12
- 11a. Sori sunken, rhizome without sclerified sheaths around the vascular strands . . . ,
..... **22. *S. heterocarpa***
- b. Sori superficial, rhizome with distinct sclerified sheaths around the vascular
 strands **15. *S. elmeri***
- 12a. Fertile parts similar to sterile part **30. *S. oodes***
- b. Fertile parts narrowed or strongly contracted 13
- 13a. Fertile parts strongly contracted, costa only distinct **35. *S. pyrolifolia***
- b. Fertile parts narrowed, veins distinct 14
- 14a. Sori in 5 or more rows between midrib and margin, margin of all fronds without
 notches or notches sporadically present **9. *S. caudiformis***
- b. Sori in one row between midrib and margin, margin of sterile fronds with notches
 regularly present **48. *S. whitfordii***

KEY TO THE SPECIES OF SULAWESI AND MOLUCCAS

- 1a. Hydathodes frequent 2
- b. Hydathodes absent or sometimes present 8
- 2a. Sclerenchyma strands in the rhizome absent or few 3
- b. Sclerenchyma strands in the rhizome many 4
- 3a. Fertile parts similar to sterile part, costa only distinct, margin of fronds with
 notches regularly present **30. *S. oodes***
- b. Fertile parts narrowed or strongly contracted, veins distinct, margin of fronds
 without notches or notches sporadically present (Philippines and Ternate) . . .
 **9. *S. caudiformis***
- 4a. Notches regularly present on margin of lamina **44. *S. taeniata***
- b. Notches absent or sporadically present on margin of lamina 5
- 5a. Vascular strands in the rhizome with bundle sheath fully sclerified (Seram) . . .
 **9. *S. caudiformis***
- b. Vascular strands in the rhizome with bundle sheath not sclerified 6
- 6a. Sori in two rows between adjacent veins (Sulawesi) **16. *S. enervis***
- b. Sori in one row between adjacent veins 7
- 7a. Sori round, in a single row between costa and margin, rhizome scales strongly
 dentate or long-ciliate, hydathodes with persistent calcareous scales, fronds usu-
 ally fully pinnate **3. *S. albidosquamata***
- b. Sori in transverse rows or coenosori, rhizome scales remotely and weakly den-
 tate, hydathodes without persistent calcareous scales, fronds simple
 **22. *S. heterocarpa***
- 8a. Sori in two rows between adjacent veins 9
- b. Sori in one row between adjacent veins 11
- 9a. Rhizome scales with squarrose, subulate, entire acumen . . **41. *S. stenosquamis***
- b. Rhizome scales with acumen flat, not squarrose, remotely and weakly to strongly
 dentate 10
- 10a. Fronds dimorphic or monomorphic, linear, fertile to c. 1.2 cm wide, costa only
 distinct, sori in 1–4 rows between midrib and margin **42. *S. subsparsa***

- b. Fronds monomorphic, fertile fronds over c.1 cm wide, veins distinct, sori in 5 or more rows between midrib and margin **16. *S. enervis***
- 11a. Sori superficial 12
- b. Sori sunken 13
- 12a. Rhizome scales obtuse, whitish, appressed, sclerenchyma strands absent or few **6. *S. bellisquamata***
- b. Rhizome scales acute or contracted to a narrow acumen, brown, spreading or squarrose, sclerenchyma strands many **32. *S. plantaginea***
- 13a. Rhizome scales contracted to a narrow subulate acumen, sori shallowly sunken **25. *S. lateritia***
- b. Rhizome scales obtuse to acute, sori deeply sunken 14
- 14a. Fertile parts similar to sterile part **40. *S. stenophylla***
- b. Fertile parts narrowed or strongly contracted 15
- 15a. Rhizome scales evenly coloured, 4.8–9 mm long, narrowly acute, vascular strands 4, costa only distinct **38. *S. soridens***
- b. Rhizome scales with a lighter margin, to 4 mm long, obtuse to acute, vascular strands 11–14, at least veins distinct **46. *S. triloba***

KEY TO THE SPECIES OF NEW GUINEA AND ADJACENT ISLANDS

- 1a. Fertile parts strongly contracted 2
- b. Fertile parts similar to sterile part or narrowed 11
- 2a. Sori in two rows between adjacent veins 3
- b. Sori in one row between adjacent veins or forming coenosori 4
- 3a. Hydathodes absent or sparse **16. *S. enervis***
- b. Hydathodes frequent **21. *S. hellwigii***
- 4a. Sori round or elongate 5
- b. Sori confluent or forming coenosori 7
- 5a. Rhizome scales entire, ground tissue with subperipheral sclerified sheath **14. *S. decockii***
- b. Rhizome scales short-dentate to long-ciliate, ground tissue not sclerified . . 6
- 6a. Margin of fronds with notches regularly present, rhizome scales strongly dentate or ciliate, fertile fronds as long as or longer than sterile ones **26. *S. lauterbachii***
- b. Margin of fronds without notches or notches sporadically present, rhizome scales short-dentate, fertile fronds usually shorter than sterile ones . . . **45. *S. tafana***
- 7a. Sori confluent across veins, forming longitudinal coenosori 8
- b. Sori confluent across connecting veins only, forming transverse coenosori . 10
- 8a. Rhizome radial (in part), sterile fronds narrow, index 6–18, sclerenchyma strands in the rhizome absent to many **18. *S. ferrea***
- b. Rhizome completely dorsiventral, sterile fronds wider, index 2–7, sclerenchyma strands in the rhizome very many 9
- 9a. Rhizome not sclerified, rhizome scales narrow, 1–1.5 mm wide, remotely and weakly to strongly dentate **11. *S. costulata***

- b. Rhizome with subperipheral sclerified sheath, rhizome scales broad, 1.8–3 mm wide, with a flabelloid, irregular margin **14. *S. dekokkii***
- 10a. Fertile fronds to c. 1.4 cm wide, index c. 10, rhizome scales densely set, covering the glaucous rhizome **4. *S. archboldii***
- b. Fertile fronds to c. 1 cm wide, index 13–14, rhizome scales sparsely set, not fully covering the glaucous rhizome **1. *S. albicaula***
- 11a. Sori in two or more rows between adjacent veins (or indistinct) 12
- b. Sori in one row between adjacent veins 14
- 12a. Lamina thickly coriaceous, margin cartilaginous, very strongly thickened **20. *S. gracilipes***
- b. Lamina chartaceous to coriaceous, margin not differentiated, flat, or thickened 13
- 13a. Fertile fronds widest above middle, midrib with two sharply distinct, raised ridges on upper surface **31. *S. pampolycarpa***
- b. Fertile fronds widest below middle or gramineous, midrib flat or with shallow ridges on upper surface **16. *S. enervis***
- 14a. Fronds pinnate 15
- b. Fronds simple 16
- 15a. Hydathodes with persistent calcareous scales, rhizome scales peltate, strongly dentate or long-ciliate, margin of fronds without notches **3. *S. albidosquamata***
- b. Hydathodes without persistent calcareous scales, rhizome scales pseudopeltate, entire or shortly dentate, margin of fronds regularly notched **44. *S. taeniata***
- 16a. Rhizome scales obtuse 17
- b. Rhizome scales acute or contracted to a narrow acumen 18
- 17a. Rhizome scales densely set, overlapping, covering the rhizome, apex flat **6. *S. bellisquamata***
- b. Rhizome scales sparsely set, not overlapping, not covering the rhizome, apex often cucullate **32. *S. plantaginea***
- 18a. Sori sunken 19
- b. Sori superficial or slightly sunken 21
- 19a. Sori in transverse coenosori, veins distinct 20
- b. Sori round, costa only distinct **40. *S. stenophylla***
- 20a. Hydathodes absent, rhizome scales with subulate acumen **25. *S. lateritia***
- b. Hydathodes frequent, rhizome scales with acumen not subulate **22. *S. heterocarpa***
- 21a. Rhizome scales contracted to a narrow acumen, with a lighter margin 22
- b. Rhizome scales acute, often with irregular dark spots 23
- 22a. Fertile fronds to c. 1.4 cm wide, index c. 10, rhizome scales densely set, covering the glaucous rhizome **4. *S. archboldii***
- b. Fertile fronds to c. 1 cm wide, index 13–14, rhizome scales sparsely set, not fully covering the glaucous rhizome **1. *S. albicaula***
- 23a. Sori 4–5 mm wide, lamina often with some persistent scales .. **13. *S. cretifera***
- b. Sori 3–4 mm wide, lamina glabrous **32. *S. plantaginea***

1. *Selliguea albicaula* (Copel.) Kato & Price

Selliguea albicaula (Copel.) Kato & Price, Acta Phytotax. Geobot. 41 (1990) 72; Hovenkamp, Blumea 43 (1998) 38. — *Polypodium albicaulum* Copel., Philipp. J. Sc., Bot. 6 (1911) 90. — *Pleopeltis albicaula* Alderw., Malayan Ferns Suppl. (1917) 383. — Type: *King* 327 (holo MICH; iso P), New Guinea.

Polypodium albarium Gepp, J. Bot. Suppl. (1923) 61. — *Selliguea albaria* Ching, Sunyatsenia 5 (1940) 260 ('albara'). — Type: *Forbes* 290 (BM), New Guinea.

Rhizome 4 mm thick, internodes to 3.5 cm long; vascular strands with bundle sheath fully sclerified; sclerenchyma strands many, mainly peripheral. *Rhizome scales* peltate, squarrose, 5.5 by 0.7 mm wide (at base), contracted to a narrow acumen, brown to blackish with a very narrow lighter margin, entire to remotely and weakly dentate. *Fronds* simple, dimorphic. Fertile fronds with stipe 2–5.5 cm long; lamina 11–14 by 0.8–1 cm, index 13.4–14, widest at 0.3–0.4 from base. Sterile fronds with stipe 1.5–4.5 cm long; lamina 13–18 by 2.5–4.5 cm, index 3.1–6.9, widest at 0.2–0.3 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes absent. Margin not differentiated or cartilaginous, flat; notches sporadically present, in fertile fronds absent. *Sori* forming transverse coenosori, 2 mm wide, superficial.

Distribution — *Malesia*: New Guinea

Habitat — Epiphytic in lightly disturbed forest (few data). Altitude 820 m.

Note — Very similar to *S. archboldii*, but the whitish rhizome with sparsely set, distinctly bicolorous scales gives this species a distinct appearance.

2. *Selliguea albidopaleata* (Copel.) Parris

Selliguea albidopaleata (Copel.) Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and Fern Allies. (1991) 151; Hovenkamp, Blumea 43 (1998) 63. — *Polypodium albidopaleatum* Copel., Philipp. J. Sc. 12 (1917) 63. — *Crypsinus albidopaleatus* Copel., Gen. Fil. (1947) 207; Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 100. — *Crypsinopsis albidopaleata* Pichi Serm., Webbia 31 (1977) 241. — Type: *Topping* 1749 (B, GH, S, SING), Borneo.

Rhizome 3–8 mm thick, internodes to 3–5.5 cm long; vascular strands with bundle sheath fully sclerified, rarely to 2 cells thick; sclerenchyma strands absent. *Rhizome scales* peltate, spreading, 6–8.5 mm long, 2–3 mm wide, apex rounded to acute, straw-coloured to brown, evenly coloured, remotely and weakly dentate, sometimes with a flabelloid margin. *Fronds* simple, monomorphic. Stipe 3.5–18 cm long; lamina 10–29 by 3.8–8.9 cm, index 2.2–4.8, widest at 0.2–0.4 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, flat (to c. 1 mm wide, translucent, fragile); notches only near apex, regularly present. *Sori*: round, or (sometimes) confluent within one areole, in two or more rows between adjacent veins (usually not in regular rows), in 5 or more rows between costa and margin, to 2 mm wide, slightly sunken with a slightly raised ridge around the receptacle. — **Fig. 28a.**

Distribution — *Malesia*: restricted to N Borneo.

Habitat — Epiphytic or terrestrial; in lower montane forest (Parris in Parris et al.: 100). Altitude 1250–2850 m.

Note — The small sori, in 2 or 3 irregular rows between the veins and with a slightly raised rim around the receptacle, distinguish this species from all others.



Fig. 28. *Seliguela albidopaleata* (Copel.) Parris. a. Fertile frond. — *S. albidosquamata* (Blume) Parris. b. Habit. — *S. rigida* (Hook.) Hovenkamp. c. Habit. — Scale bars = 1 cm. Drawings by J. Wessendorp. Reproduced from Blumea 43 (1998).

3. *Seliguela albidosquamata* (Blume) Parris

Seliguela albidosquamata (Blume) Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 152; Hovenkamp, Blumea 43 (1998) 44. — *Polypodium albedo-squamatum* Blume, Enum. Pl. Javae (1828) 132; Fl. Javae Filic. (1829) 137; Hook., Gard. Ferns (1862) pl. 47; Sp. Fil. (1864) 92 ('albo-squamatum'); Baker, Syn. Fil. (1868) 369 ('albo-squamatum'); Alderw., Malayan Ferns (1908) 668 ('albidosquamatum'); Backer & Posth., Varenfl. Java (1939) 217. — *Phymatodes albedo-squamata* J. Sm., Ferns Brit. & For. (1866) 94 ('albo-squamata'). — *Pleopeltis albidosquamata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10; Malayan Ferns Suppl. (1917) 401. — *Crypsinus albidosquamatus* Copel., Gen. Fil. (1947) 207; Holttum, Revis. Fl. Malaya 2 (1954) 195; Copel., Fern Fl. Philipp. (1960) 501; Kato & Price, Acta Phytotax. Geobot. 41 (1990) 70. — *Phymatopsis albidosquamata* Ching, Acta Phytotax. Sin. 9 (1964) 191. — *Phymatopteris albedo-squamata* Pichi Serm., Webbia 28 (1973) 461. — Type: Reinwardt s. n. (L), Celebes.

Polypodium varians Blume, Enum. Pl. Javae (1828) 132; Fl. Javae Filic. (1829) 138. — *Pleopeltis varians* T. Moore, Index Filic. II (1862) 344. — *Polypodium albedo-squamatum* var. *variens* Alderw., Malayan Ferns (1908) 668. — *Pleopeltis albedo-squamata* var. *variens* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10. — Type: Blume s. n. (L), Java.

- Polypodium subaquatile* H. Christ, Ann. Jard. Bot. Buitenzorg II, 5 (1905) 124; Alderw., Malayan Ferns (1908) 668. — *Pleopeltis subaquatilis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10. — Type: *Jaheri* 214 (BM, BO, L, P), Celebes.
- Polypodium longicuspe*, C. Chr., Leafl. Philipp. Bot. 9 (1933) 3167; Copel., Fern Fl. Philipp. (1960) 501 (tentatively under *P. albedo-squamatum*). — Type: *Elmer* 22107 (B, BM, K, UC), Philippines, Luzon.
- Polypodium bellivenosum* C. Chr., Brittonia 2 (1937) 312. — *Crypsinus bellivenosus* Copel., Gen. Fil. (1947) 207. — *Phymatopteris bellivenosa* Pichi Serm., Webbia 31 (1977) 249. — Type: *Brass* 4860 (BM, BO, NY), New Guinea.

Rhizome 5–10 mm thick, internodes to 1–4 cm long; vascular strands with bundle sheath absent to hyaline; sclerenchyma strands very many. **Rhizome scales** peltate, spreading to squarrose, 7–23 by 1–2.5 mm, acute to contracted to a narrow, often recurved acumen, brown and evenly coloured to blackish with a dark central pseudocosta and a lighter margin (margin often absent in the subulate acumen); margin strongly dentate to long-ciliate, cilia often also present on the exposed parts of the surface. **Fronds** pinnate, monomorphic to slightly (internally) dimorphic. Fertile fronds with 2–18 pairs of pinnae and a conform terminal pinna; stipe 10–51 cm long; lamina 26–83 cm long; largest fertile pinna is 1st or 2nd from base, stalk 0.3–1.0 cm, blade 11–31 by 0.4–2.5(–7) cm, cusp 1.3–7 cm, widest at 3.5–11 cm, with 1–7 rows of closed areoles. Sterile fronds with up to 9 pairs of pinnae; lamina 19–40 cm long (or longer); largest sterile pinna 9.5–22 by 0.3–4.3 cm. **Venation**: main veins on upper surface raised, distinct, often veinlets distinct as well, veinlets free or anastomosing, free veinlets in the areoles excurrent and recurrent, a distinct row of excurrent marginal veinlets present. Hydathodes frequent (especially on the marginal veinlets), with persistent calcareous scales. Margin cartilaginous, flat to (sometimes) thickened, without notches, but sometimes crenate. **Sori** round (sometimes slightly elongated towards margin), in one row between adjacent veins, in one row between costa and margin, at 1–6(–13) mm from the costa, 1.5–4 mm wide, superficial to slightly sunken. — **Fig. 28b.**

Distribution — Throughout *Malesia*, but apparently very local or absent in Peninsular Malaysia, Java and the Lesser Sunda Islands.

Habitat — In primary forest, secondary forest, scrubland, on disturbed sites etc., often near streams. Low to high epiphyte, epilithic and terrestrial. Common in most localities. Altitude from sea level to 3500 m.

Note — In West Malesia (Sumatra, Java, Borneo) the rhizomes are mostly short and thick, set with very long, dark-coloured rhizome scales with a recurved, subular, ciliate acumen. In East Malesia most specimens have thinner, more widely creeping rhizomes with brown, dentate-ciliate scales.

4. *Selliguea archboldii* Copel

- Selliguea archboldii* Copel., J. Arnold Arbor. 24 (1943) 442; Hovenkamp, Blumea 43 (1998) 38. — Type: *Brass* 6836 (BM, GH, UC), New Guinea.

Rhizome 2–3 mm thick, internodes to 1.5–3 cm long; vascular strands with bundle sheath fully sclerified; sclerenchyma strands many to very many. **Rhizome scales** peltate, spreading to squarrose, 6.5 by 1–1.3 mm (width at base), acute or contracted to a narrow acumen; acumen brown to blackish with a very narrow lighter margin,

entire to remotely and weakly dentate. *Fronde*s simple, dimorphic. Fertile fronds with stipe 6–8 cm long; lamina 10.5–14.5 by 1.1–1.4 cm, index 9.6–10, widest at 0.3–0.5 from base. Sterile fronds with stipe 4.5–6 cm long; lamina 15–17 by 3.3–4.8 cm, index 3.3–4.9, widest at 0.3–0.4 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes absent. Margin not differentiated or cartilaginous, flat or slightly thickened; notches sporadically to regularly present, in fertile fronds absent to regularly present. *Sori* in transverse coenosori, 2 mm wide, superficial.

Distribution — *Malesia*: New Guinea.

Habitat — Epiphytic. Altitude 600–1220 m.

Note — Recognisable by the very narrow scales and consistently continuous coenosori. *Selliguea albicaula* is similar, but differs in having the scales much more sparsely set on a distinctly white-waxy rhizome and in the almost clathrate structure of the thick costa of the scales. However, there are some intermediate specimens, and it is possible that the specific distinction can no longer be upheld as more material becomes available.

5. *Selliguea bakeri* (Luer ss.) Hovenkamp

Selliguea bakeri (Luer ss.) Hovenkamp, Blumea 43 (1998) 90. — *Polypodium torulosum* Baker, J. Bot. n.s. 9 (1880) 215, nom. illeg., non Baker (1877). — *Polypodium bakeri* Luer ss., Abh. Nat. Ver. Bremen 7 (1882) 48; Alderw., Malayan Ferns (1908) 632. — *Pleopeltis bakeri* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — *Crypsinus bakeri* Tagawa, Acta Phytotax. Geobot. 25 (1973) 180. — Type: *Beccari 445* (BM, BO, K), Sumatra

Pleopeltis pseudo-lateralis Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 36. — Type: *Bünnemeijer 772* (holo BO; iso L), Sumatra.

Rhizome 2–3 mm thick; internodes to 0.5–2 cm long; vascular strands with bundle sheath hyaline or fully sclerified; sclerenchyma strands many. *Rhizome scales* peltate, spreading, 4–8 by 1–1.5 mm, acute, brown, evenly coloured or (rarely) with a lighter margin, strongly dentate. *Fronde*s simple, strongly dimorphic. Fertile fronds with stipe 8–19 cm long; lamina linear, 12–19 by 0.2–0.4 cm. Sterile fronds with stipe 2–11 cm long; lamina 5–12 by 5–4 cm, index 1.7–4.5, widest at 0.3–0.5 from base. *Venation*: main veins on upper surface not raised or raised, distinct. Hydathodes absent or (occasionally) present, calcareous scales not persistent. Margin cartilaginous, thickened; without notches (sometimes), or notches regularly present but absent in fertile fronds. *Sori* elongate, in one row between adjacent veins, in one row between costa and margin, 2–4 mm wide, superficial to (rarely) slightly sunken. — **Fig. 28c, 30c.**

Distribution — *Malesia*: Sumatra.

Habitat — Epiphytic, often in moss-cushions, occasionally on thin twigs or trunks. In open scrub, mossy forest, or in tree crowns. Altitude 1500–3300 m.

Note — The sori occasionally coalesce into longitudinal coenosori.

6. *Selliguea bellisquamata* (C. Chr.) Hovenkamp

Selliguea bellisquamata (C. Chr.) Hovenkamp, Blumea 43 (1998) 39. — *Polypodium bellisquamatum* C. Chr., Brittonia 2 (1937) 313. — Type: *Brass 4053* (BM, BO, GH, NY), New Guinea. *Selliguea brachylepidota* Copel., Univ. Calif. Publ. Bot. 18 (1942) 226. — Type: *Clemens 41008* (UC), New Guinea.

Rhizome 4–5 mm thick, internodes to 1.5–4 cm long; vascular strands with bundle sheath fully sclerified to sclerified, 2 cells thick; sclerenchyma strands very many. *Rhizome scales* peltate, appressed, 5–9.5 by 2.3–3 mm, obtuse, straw-coloured to brown, with a lighter flabelloid margin, entire. *Fronds* simple, dimorphic. Fertile fronds with stipe 1–12 cm long; lamina 9–21 by 1.4–3.1 cm, index 3–7.9, widest at 0.2–0.5 from base. Sterile fronds with stipe 2–8.5 cm long; lamina 12–21 by 2.4–4.7 cm, index 1.8–5.2, widest at 0.3–0.5 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes absent. Margin not differentiated to cartilaginous, flat to thickened; notches sporadically to regularly present. *Sori* round, elongate or confluent to coenosorus, confluent across connecting veins (occasionally confluent within one areole), in one row between adjacent main veins (occasionally in 2 rows), in 5 or more rows between costa and margin, 2–4 mm wide, slightly sunken.

Distribution — *East Malesia*: Sulawesi to New Guinea.

Habitat — Epiphytic; in mid-montane or mossy mountain forest, occasionally terrestrial on cliffs, road banks or in rock crevices. Altitude: 1300–2700 m.

Note — Material from Sulawesi and the Moluccas is slightly different: the rhizome is thinner, 2–3 mm thick, with few (4–6) vascular strands and no or few, mainly central, sclerenchyma strands, and a peripheral sclerified sheath. Rhizome scales 3–7 by 1.5–3 mm, whitish. Sori confluent to transverse coenosori.

7. *Selliguea bisulcata* (Hook.) Hovenkamp

Selliguea bisulcata (Hook.) Hovenkamp, Blumea 43 (1998) 73. — *Grammitis bisulcata* Hook., A Century of Ferns (1854) Tab. 98. — *Holcosorus pentagonus* T. Moore, Index Filic. (1857) 30. — *Holcosorus bisulcatus* Copel., Gen. Fil. (1947) 208. — Type: *Lobb s.n.* (K), Sarawak.

Rhizome 1.5 mm thick, internodes to 0.5 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands many. *Rhizome scales* peltate, spreading, 5.5 by 0.9 mm, contracted to a narrow acumen, brown, with a central pseudocosta and a lighter margin; base dentate; acumen entire. *Fronds* simple, monomorphic. Stipe 0.5–1.5 cm long (distinction from lamina often not clear). Lamina 5–30 by 0.1–0.2 cm or longer, gramineous. *Venation* strongly reduced, costa distinct; main veins on upper surface not raised. Hydathodes absent. Margin not differentiated, without notches. *Sori* elongate (sometimes seemingly forming a coenosorus), in two rows between adjacent veins, in one row between costa and margin, 1 mm wide, in a deep laminar groove.

Distribution — *Malesia*: Borneo. Obviously rare. Outside Malesia once reported from India.

Habitat — Epiphytic or terrestrial; in forest. Altitude 100–850 m.

Note — This species has been confused with other species or forms with gramineous fronds (see under *S. ceratophylla*, *S. enervis*, *S. lateritia*, *S. setacea*). All of these can be distinguished by the wider lamina, which is flat or slightly incurved in cross section. True *S. bisulcata* has an almost quadrangular cross section of the lamina, and a rhizome with the fronds distinctly spaced.

8. *Selliguea brooksii* (Alderw.) Hovenkamp

Selliguea brooksii (Alderw.) Hovenkamp, Blumea 43 (1998) 93. — *Drymoglossum brooksii* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 21. — *Grammatopteris brooksii* Alderw., Bull.

Jard. Bot. Buitenzorg III, 4 (1922) 318. — *Grammatopteridium costulatum* var. *brooksii* C. Chr., Dansk Bot. Ark. 6 (1929) 81. — *Grammatopteridium brooksii* Copel., Gen. Fil. (1947) 208. — Type: *Brooks 361/S* (holo BO; iso BM), Sumatra.

Rhizome 2–3 mm thick, internodes to 1 cm long; vascular strands 6–9, bundle sheath hyaline; sclerenchyma strands many to very many. *Rhizome scales* peltate, spreading, 3.5–5 by 0.5–1 mm, acute, straw-coloured to brown, evenly coloured or with a lighter margin, shortly dentate (occasionally) to strongly dentate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 6–24 cm long; lamina 4–18 by 0.1–0.2 cm, linear. Sterile fronds with stipe 2–8 cm long; lamina 3.5–9.5 by 1.7–5.5 cm, index 1.2–3.6, widest at 0.2–0.5 from base; base truncate to cordate, apex rounded. *Venation*: main veins on upper surface not raised or raised, distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes on fertile fronds present, calcareous scales not persistent, absent on sterile fronds. Both surfaces distinctly dotted with conspicuous glands in small depressions. Margin cartilaginous, thickened; notches sporadically to (more often) regularly present, absent in fertile fronds. *Sori* forming a single, longitudinally elongated coenosorus between costa and margin, 1–3 mm wide, superficial.

Distribution — *Malesia*: restricted to Sumatra.

Habitat — Epiphytic or epilithic; mossy forest or exposed. Altitude 1440–1850 m.

Notes — *Selliguea brooksii* can be distinguished from the equally coenosoroid species *S. murudensis* and *S. costulata* as follows:

Selliguea murudensis: Plants usually smaller, slenderer. Fronds thinner, less coriaceous. Lamina-base usually more narrowly cuneate. Surfaces not distinctly glandular (inconspicuous glands may be present). Always at least a few hydathodes present, also on sterile fronds.

Selliguea costulata: Often large plants. Rhizome widely creeping, bundle sheaths of the vascular strands heavily sclerified. Hydathodes never present in fertile nor sterile fronds. Surface not distinctly glandular.

The present species may also be confused with *S. pseudoacrostichum*, recognizable by the more gradually cuneate lamina base and the separate sori.

9. *Selliguea caudiformis* (Blume) Carruth.

Selliguea caudiformis (Blume) Carruth., Flora Vitiensis (1873) 370; J. Sm., Ferns Brit. & For. (1866) 97; Hist. Fil. (1875) 102; Hovenkamp, Blumea 43 (1998) 31. — *Polypodium caudiforme* Blume, Enum. Pl. Javae (1828) 122; Fl. Javae Filic. (1829) 146. — *Polypodium feei* (Bory) Mett. var. *caudiforme* Alderw., Malayan Ferns (1908) 676. — *Pleopeltis feei* var. *caudiformis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — *Pleopeltis caudiformis* Alderw., Malayan Ferns Suppl. (1917) 383. — Type: *Reinwardt s.n.* (L, BO), Celebes.

Polypodium phlebiscopum Baker, J. Linn. Soc. Bot. 15 (1876) 110; Alderw., Malayan Ferns (1908) 648. — *Pleopeltis phlebiscopa* Alderw., Malayan Ferns Suppl. (1917) 386. — *Selliguea phlebiscopa* Pichi Serm., Webbia 31 (1977) 249. — Type: *Moseley s.n.* (BM, K, L), Moluccas, Ternate.

Polypodium calophlebium Copel., Philipp. J. Sc., Bot. 2 (1907) 140; Alderw., Malayan Ferns (1908) 676. — *Pleopeltis calophlebia* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12; Malayan Ferns Suppl. (1917) 406. — *Selliguea calophlebia* Copel., Fern Fl. Philipp. (1960) 508; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 159. — Type: *Merrill 5989* (GH, P), Philippines, Mindoro.

Selliguea feei auct. non Bory: Kato & Price, Acta Phytotax. Geobot. 41 (1990) 72 (most specimens cited).

Rhizome 2–5 mm thick, internodes to 2–4.5 cm long; vascular strands with bundle sheath fully sclerified, rarely 2 cells thick; sclerenchyma strands absent. *Rhizome scales* peltate, appressed to spreading (mostly), 4.5–6.5 by 1–2 mm, acute, brown, evenly coloured or with a lighter margin, entire to remotely and weakly dentate, rarely short-dentate, often with irregular protuberances. *Fronds* simple, dimorphic. Fertile fronds with stipe 5.5–24 cm long; lamina 6–21 by 1.7–6 cm, index 2.8–5.2, widest at 0.2–0.4 from base. Sterile fronds with stipe 2–19 cm long; lamina 6–22 by 2–9.5 cm, index 1.7–3.4, widest at 0.2–0.4 from base; base cuneate, apex obtuse, acute, to acuminate/caudate. *Venation*: main veins on upper surface raised, distinct. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened; without notches or notches sporadically present. *Sori* round to elongate, occasionally confluent across the connecting veins to transverse coenosori, in one row between adjacent main veins (rarely in two rows), in 5 or more rows between costa and margin (rarely less), 3–4 mm wide, superficial to slightly sunken.

Distribution — *Malesia*: S Philippines, Sulawesi, Moluccas.

Habitat — Epiphytic or epilithic on tree trunks, or terrestrial, and on rocks, mostly in open or mossy forest, on summits or ridges. Altitude 980–2500 m, possibly higher.

Notes — 1. A characteristic difference between this species and the closely related *S. feei* is the disposition of the sori, which in *S. caudiformis* are usually separate, with a distinct and well-developed costal row often clearly distinct from the other sori which are more near the margin. *Selliguea caudiformis* differs from *S. feei* moreover in the more distinctly acuminate lamina, and from *S. plantaginea* and related species mainly in the usually somewhat wider rhizome scales and the presence of hydathodes. However, the distinctions are not completely sharp.

2. Specimens from Sulawesi and the Moluccas may differ, with more strongly contracted fronds, and fewer sori between costa and margin.

10. *Selliguea ceratophylla* (Copel.) Hovenkamp

Selliguea ceratophylla (Copel.) Hovenkamp, Blumea 43 (1998) 86. — *Polypodium ceratophyllum* Copel., Philipp. J. Sc., Bot. 6 (1909) 348. — *Pleopeltis ceratophylla* Alderw., Malayan Ferns Suppl. (1917) 395. — Type: *Foxworthy 205* (MICH), Borneo.

Polypodium angustato-decurrens Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 13 (1914) 221. — Type: *J. Winkler 79a* (UC), Sumatra.

Pleopeltis lucidula Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 58; Malayan Ferns Suppl. (1917) 389. — *Polypodium lucidulum* C. Chr., Index Filic. Suppl. prél. (1917) 26. — Type: *C.G. Matthew 706 A* (BO, K, US), Sumatra.

Polypodium occultivenium Copel., Philipp. J. Sc., Bot. 12 (1917) 63. — *Crypsinus occultivenius* Copel., Gen. Fil. (1947) 207. — *Crypsinopsis occultivenia* Pichi Serm., Webbia 31 (1977) 242. — Type: *Brooks s.n.* (MICH), Borneo.

Polypodium clemensiae Copel., Brittonia 1 (1931) 76. — Type: *Clemens 20449* (NY, UC), Borneo. *Crypsinus subfasciatus* Holttum, Revis. Fl. Malaya 2 (1954) 202. — Type: *Holttum SFN 21559* (BM, K, SING), Malaya.

Rhizome 2–6 mm thick, internodes to 0.2–1 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands very many. *Rhizome scales* pseudopeltate, or

rarely peltate, spreading, 2–3.5 by 0.6–1.3 mm, acute, brown, evenly coloured, short-dentate to strongly dentate. *Fronds* simple, dimorphic. Fertile fronds with stipe 2–12 cm long; lamina 5–29 by 0.9–4.1 cm, index 5.8–10, widest at 0.5–0.7 from base. Sterile fronds with stipe 1–7 cm long; lamina 5–22 by 1–4.3 cm, index 3.1–5.6, widest at (0.4–)0.5–0.6 from base; base very gradually narrowed, apex acuminate in fertile, rounded in sterile fronds. *Venation*: costa only distinct, or main veins also distinct, raised on upper surface, veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin cartilaginous, thickened; without notches (rarely), or notches regularly present. *Sori* round, rarely elongate, confluent within one areole, in 2(–4) rows between adjacent veins, in (2–)5 rows between costa and margin, (0.5–)1.5–2 mm wide, superficial or very slightly sunken. — **Fig. 30i.**

Habitat — Trunk or branch epiphyte, occasionally terrestrial, in forest. Altitude 650–1900 m.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Borneo.

Notes — 1. A small, furcate form has occasionally been collected.

2. *Crypsinus subfasciatus* is a very narrow form, with fertile fronds narrowly linear, to 28 by 0.7–1 cm. It is easily confused with *S. setacea*, which differs in the still narrower fronds without notches, and the hypodermis with thickened cell walls.

3. *Selliguea ceratophylla* can be distinguished from *S. enervis* by the short rhizome, with the phyllopods very close together; the pseudopeltate scales, which are usually more strongly dentate and have a somewhat coarser cell-net than in *S. enervis*, and the spatulate fronds, which are more gradually narrowed at the base than in *S. enervis*.

11. *Selliguea costulata* (Ces.) Wagner & Grether

Selliguea costulata (Ces.) Wagner & Grether, Univ. Calif. Publ. Bot. 23 (1948) 60; Kato & Price, Acta Phytotax. Geobot. 41 (1990) 72; Hovenkamp, Blumea 43 (1998) 42. — *Acrostichum costulatum* Ces., Rendic. Reale Accad. Sci. Fis. 16 (1877) 30. — *Polypodium costulatum* Baker, J. Bot. n.s. 9 (1880) 215; Alderw., Malayan Ferns (1908) 644. — *Pleopeltis costulata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6. — *Grammatopteridium costulatum* C. Chr., Dansk Bot. Ark. 6 (1929) 80. — Type: *Beccari s.n.* (FI, n.v.), Ansus I.

Polypodium iboense Brause, Bot. Jahrb. Syst. 49 (1912) 50. — *Pleopeltis iboensis* Alderw., Malayan Ferns Suppl. (1917) 386. — Syntypes: *Schlechter 17106* (B, BM), *19017* (B, L, UC), New Guinea.

Grammatopteris pseudodrymoglossum Alderw., Bull. Jard. Bot. Buitenzorg III, 4 (1922) 318. — *Grammatopteridium pseudodrymoglossum* C. Chr., Dansk Bot. Ark. 6 (1929) 82. — Type: *Lam 826* (holo BO; iso L), New Guinea.

Grammatopteris brooksii Alderw. var. *beguinii* Alderw., Bull. Jard. Bot. Buitenzorg III, 4 (1922) 318. — *Grammatopteridium costulatum* var. *beguinii* C. Chr., Dansk Bot. Ark. 6 (1929) 81. — Type: *Beguin 1095* (?BO, not traced), Moluccas, Ternate.

Rhizome 2.5–5 mm thick, internodes to 1–5 cm long; vascular strands with bundle sheath fully sclerified; the sclerenchyma strands very many. *Rhizome scales* peltate, spreading to (rarely) squarrose, 3–7 by 1–1.5 mm, acute, straw-coloured to brown, evenly coloured (rarely), or with a lighter margin, remotely and weakly to strongly dentate. *Fronds* simple, dimorphic. Fertile fronds with stipe 2–19 cm long; lamina 3.5–32 by 0.2–0.3(–0.8) cm, linear. Sterile fronds with stipe 0.5–18 cm long; lamina 4.5–20 by 0.7–6.8(–10) cm, index 2.1–6.5, widest at 0.2–0.5 from base; apex rounded

to long-acuminate. *Venation*: main veins on upper surface raised, distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin cartilaginous, flat (rarely) or thickened; notches sporadically to regularly present, absent in fertile fronds. *Sori* in a longitudinal coenosorus (often interrupted), or (rarely, in transitional fronds) transversely elongated, singly between costa and margin, 2–4 mm wide, superficial.

Distribution — *Malesia*: Moluccas to New Guinea.

Habitat — Epiphytic; low down on trunks to high up in crowns. Altitude from sea level to 1600 m.

Note — Small forms from the mainland of New Guinea can only be distinguished from *S. lauterbachii* by the coenosori.

12. *Selliguea craspedosora* (Copel.) Hovenkamp

Selliguea craspedosora (Copel.) Hovenkamp, Blumea 43 (1998) 72. — *Polypodium craspedosorum* Copel., Philipp. J. Sc., Bot. 9 (1914) 233. — *Pleopeltis craspedosora* Alderw., Malayan Ferns Suppl. (1917) 378. — *Crypsinus craspedosorus* Copel., Gen. Fil. (1947) 206. — Type: Brooks 134 (BM, P), Sumatra.

Rhizome 1 mm thick, internodes to 1 cm long; vascular strands with bundle sheath absent to hyaline; sclerenchyma strands many. *Rhizome scales* peltate, squarrose, 6 by 1 mm wide, contracted to a narrow acumen, brown, evenly coloured, entire (dentate at base). *Fronds* simple, dimorphic. Fertile fronds with stipe 2.5–4.5 cm long; lamina 27–29 by 0.4–0.5 cm, linear. Sterile fronds with stipe 0.5–3.5 cm long; lamina 4–12 by 0.6–1 cm, index 4.5–20, widest at 0.5–0.7 from base. *Venation*: costa only distinct. Hydathodes absent. Margin cartilaginous, thickened, without notches. *Sori* round to elongate, confluent within one areole and across connecting veins, in one row between costa and margin, 2 mm wide, superficial to slightly sunken.

Distribution — *Malesia*: Sumatra.

Habitat — Epiphytic; on trunk. Altitude not indicated.

Note — Similar to *S. subsparva*, but differs most strikingly in the scales, which match those of *S. lateritia*: they are dull brown, from a wide base suddenly contracted to a narrow, entire acumen. The sori are distinctly closer to the margin than to the costa.

13. *Selliguea cretifera* (Alderw.) Ching

Selliguea cretifera (Alderw.) Ching, Sunyatsenia 5 (1940) 260; Hovenkamp, Blumea 43 (1998) 37. — *Pleopeltis cretifera* Alderw., Nova Guinea 16 (1924) 40. — Type: Lam 1809 (BO, L, SING, UC), New Guinea.
Polypodium crassissorum C. Chr., Brittonia 2 (1937) 313. — Type: Brass 4201 (BM, BO, NY, P), New Guinea.

Rhizome 3–6.5 mm thick, internodes to 2.5–3 cm long. Vascular strands with bundle sheath fully sclerified, to 2 cells thick; sclerenchyma strands many to very many. *Rhizome scales* peltate, spreading to squarrose, 4–4.5 by 1–1.3, acute, brown to blackish, evenly coloured or with irregular dark spots, remotely and weakly dentate to short-dentate. *Fronds* simple, dimorphic to strongly dimorphic. Fertile fronds with stipe 8.5–9.5 cm long; lamina 11–14 by 1.4–2.2 cm, or longer, index 5–10, widest at

0.3 from base. Sterile fronds with stipe 3–8.5 cm long; lamina 14–18 by 4.1–6.6 cm, index 2.3–3.6, widest at 0.2–0.4 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes absent. Margin not differentiated to cartilaginous, flat; notches absent or (rarely) present. *Sori* elongate to transverse coenosori, singly between adjacent veins, 4–5 mm wide, superficial.

Distribution — *Malesia*: New Guinea, throughout the mountain ranges.

Habitat — Epiphytic or terrestrial; montane to subalpine forest, often pendent from branches. Altitude 1650–3800 m.

Note — *Selliguea cretifera* is similar to *S. plantaginea* and *S. tafana*, and difficult to distinguish from either. It is best recognised by the relatively thick coenosori. A few persistent scales may be found on the lamina.

14. *Selliguea dekokkii* (Alderw.) Hovenkamp

Selliguea dekokkii (Alderw.) Hovenkamp, *Blumea* 43 (1998) 40. — *Pleopeltis dekokkii* Alderw., *Bull. Jard. Bot. Buitenzorg II*, 1 (1911) Appendix; *Malayan Ferns Suppl.* (1917) 382; *Nova Guinea* 1 (1924) 39. — *Crypsinus dekokkii* Copel., *Gen. Fil.* (1947) 206. — Type: *de Kock 44* (BO), New Guinea.

Polypodium prolixum Rosenst., *Nova Guinea* (1912) 727. — Syntypes: *von Römer 717* (BO), 1035 (L), New Guinea.

Polypodium argyropus Ridl., *Trans. Linn. Soc. London* 1 (1916) 262. — Type: *Boden Kloss s.n.* (BM, K), New Guinea.

Rhizome 4–5 mm thick, internodes to 1.5–3.5 cm long. Vascular strands with bundle sheath fully sclerified, to 2 cells thick; sclerenchyma strands very many; sclerified sheath present. *Rhizome scales* peltate, appressed to spreading, 7–9.5 by 1.8–3 mm, acute (apex often wrinkled), whitish to brown, evenly coloured or with a lighter margin, rarely with irregular dark spots, entire, with a very irregular flabelloid margin. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe indistinct, 2–8 cm long; lamina 12–22.5 by 0.2–0.4 cm (to 1.3 cm wide in intermediate fronds), linear. Sterile fronds with stipe 0.5–5 cm long; lamina 5–14.5 by 1.5–3.5 cm, index 2.9–7.2, widest at 0.2–0.4 from base. *Venation*: main veins on upper surface not raised or raised, distinct. Hydathodes absent. Margin cartilaginous or concolorous, flat to thickened; notches sporadically to (mostly) regularly present, in fertile fronds sometimes absent. *Sori* longitudinally elongate or forming short transverse coenosori (in transitional fronds), in one row between adjacent veins, in one row between costa and margin, 3–4 mm wide, superficial.

Distribution — *Malesia*: mainland of New Guinea.

Habitat — Epiphytic; primary or secondary forest. Altitude 1250–2400 m.

Note — *Selliguea dekokkii* is close to *S. bellisquamata*, and might be regarded as merely a dimorphic variant of the latter, were it not for the constant differences in rhizome structure (the distinct sclerenchyma sheath) and rhizome scales (acute, with a wrinkled apex).

15. *Selliguea elmeri* (Copel.) Ching

Selliguea elmeri (Copel.) Ching, *Sunyatsenia* 5 (1940) 260; Copel., *Fern Fl. Philipp.* (1960) 508; Hovenkamp, *Blumea* 43 (1998) 30. — *Polypodium elmeri* Copel. in Perkins, *Fragm. Fl. Philipp.*

3 (1905) 191; Alderw., *Malayan Ferns* (1908) 675. — *Pleopeltis elmeri* Alderw., *Bull. Dép. Agric. Indes Néerl.* 27 (1909) 12; *Malayan Ferns Suppl.* (1917) 405. — *Selliguea feei* var. *elmeri* Tagawa, *Acta Phytotax. Geobot.* 16 (1956) 78. — Type: *Elmer 6547* (B, UC), Philippines, Luzon.

Rhizome 4–6 mm thick, internodes to 1.5–3.5 cm long; vascular strands with bundle sheath fully sclerified; sclerenchyma strands few to many, mainly around the vascular cylinder. *Rhizome scales* peltate, appressed, 3.5–6 by 1.6–3.4 mm, acute, brown (with a large dark spot at the attachment), evenly coloured or with a lighter margin, entire to remotely and weakly dentate (sometimes irregularly lacerate). *Fronds* simple, dimorphic. Fertile fronds with stipe 14–30 cm long; lamina 7–13 by 1.9–3.5 cm, index 2–4.7, widest at 0.2–0.4 from base. Sterile fronds with stipe 3.5–27 cm long; lamina 5.5–14 by 4–12.3 cm, index 1.4–2.3, widest at 0.3–0.4 from base; base mostly truncate, apex rounded, rarely acute. *Venation*: main veins on upper surface not raised, distinct. Hydathodes absent. Margin cartilaginous, thickened; notches present, in fertile fronds absent to sporadically present. *Sori* in transverse coenosori, confluent across connecting veins, singly between adjacent main veins, 3 mm wide, superficial.

Distribution — *Malesia*: Philippines (northern Luzon).

Habitat — Epiphytic or epilithic; in pine forests. Altitude 1500–2250 m.

Note — A fairly distinct segregate of the *Selliguea feei*-complex, with a restricted distribution. The shape of the lamina is usually characteristic, with an abruptly contracted base and a rounded apex.

16. *Selliguea enervis* (Cav.) Ching

Selliguea enervis (Cav.) Ching, *Bull. Fan Mem. Inst. Biol.* 10 (1941) 239; Hovenkamp, *Blumea* 43 (1998) 74. — *Polypodium enerve* Cav., *Descr. Pl.* (1802) 245; Sw., *Syn. Fil.* (1806) 28; C. Chr., *Dansk Bot. Ark.* 9 (1937) 12, pl. 1, f. 4; Backer & Posth., *Varenfl. Java* (1939) 200. — *Crypsinus enervis* Copel., *Gen. Fil.* (1947) 207; Holttum, *Revis. Fl. Malaya* 2 (1954) 199; Copel., *Fern Fl. Philipp.* (1960) 506; Kato & Price, *Acta Phytotax. Geobot.* 41 (1990) 71. — *Crypsinopsis enervis* Pichi Serm., *Webbia* 31 (1977) 242. — Type: *Née s.n.* (MA, teste C. Chr., l.c.), Philippines, ?Luzon, 'Marianas'.

Polypodium rupestre Blume, *Enum. Pl. Javae* (1828) 124, nom. illeg., non R. Br. (1810) (= *Pyrrosia*); *Fl. Javae Filic.* (1829) 142; Baker, *Syn. Fil.* (1868) 359; Alderw., *Malayan Ferns* (1908) 650. — *Pleuridium rupestre* Fée, *Gen. Filic.* (1850–1852) 274; J. Sm., *Ferns Brit. & For.* (1866) 95. — *Polypodium saxatile* Hook., *Sp. Fil.* 5 (1864) 63, nom. illeg., non Klotzsch (1847). — *Pleopeltis rupestris* Bedd., *Suppl. Ferns Brit. India* (1892) 94. — *Polypodium subtriquetrum* H. Christ, *J. Bot. (Morot)* II, 1 (1908) 267, nom. superfl. — *Pleopeltis rupestris* T. Moore, *Index Filic.* (1857) 78; Alderw., *Mal. Ferns Suppl.* (1917) 387. — Type: *Blume s.n.* (L), Java.

Polypodium induratum Baker, *Ann. Bot. (London)* 5 (1891) 92; Alderw., *Malayan Ferns* (1908) 637. — *Pleopeltis indurata* Alderw., *Bull. Dép. Agric. Indes Néerl.* 27 (1909) 5; *Malayan Ferns Suppl.* (1917) 379. — Type: *Müller s.n.* (BM, K), New Guinea.

Polypodium lagopodioides H. Christ, *Ann. Jard. Bot. Buitenzorg* 4 (1904) 37, nom. illeg., non Desvaux (1811). — *Polypodium album* H. Christ in C. Chr., *Index Filic.* (1906) 508. — *Pleopeltis albula* Alderw., *Bull. Dép. Agric. Indes Néerl.* 27 (1909) 7. — Type: *Sarasin 2041* (P), Celebes.

Polypodium rupestre Blume var. *leucolepis* Rosenst., *Feddes Repert. Spec. Nov. Regni Veg.* 5 (1908) 43; Alderw., *Malayan Ferns* (1908) 651. — *Pleopeltis rupestris* var. *leucolepis* Alderw., *Bull. Dép. Agric. Indes Néerl.* 27 (1909) 7. — *Polypodium leucolepis* Rosenst., *Feddes Repert. Spec. Nov. Regni Veg.* 12 (1913) 180, nom. illeg. non Gilbert (1897). — Type: *Werner 39* (BM, L, UC), New Guinea.

- Polypodium taeniopsis* H. Christ, Verh. Naturf. Ges. Basel 11 (1896) 443. — *Polypodium rupestre* Blume var. *taeniopsis* Alderw., Malayan Ferns (1908) 651. — *Pleopeltis rupestris* var. *taeniopsis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7. — Type: *Sarasin 1346* (not found), Celebes.
- Polypodium holosericeum* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 5 (1908) 375. — Type: *Werner ROS 32* (L), New Guinea.
- Polypodium cochleare* Brause, Bot. Jahrb. Syst. 49 (1912) 48. — *Pleopeltis cochlearis* Alderw., Malayan Ferns Suppl. (1917) 387. — Type: *Schultze (33) 14* (B), New Guinea.
- Polypodium limaeforme* Brause, Bot. Jahrb. Syst. 49 (1912) 49. — *Pleopeltis limaeformis* Alderw., Malayan Ferns Suppl. (1917) 389. — Type: *Schultze (33) 17* (B), New Guinea.
- Polypodium rhomboideum* Brause, Bot. Jahrb. Syst. 49 (1912) 46, nom. illeg., non Blume (1828). — *Pleopeltis rhomboidea* Alderw., Malayan Ferns Suppl. (1917) 389. — Type: *Schlechter 19090* (B, BM, P), New Guinea.
- Polypodium undulato-sinuatum* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 12 (1913) 179. — *Pleopeltis undulato-sinuata* Alderw., Malayan Ferns Suppl. (1917) 388. — *Crypsinus undulato-sinuatus* Copel., Gen. Fil. (1947) 207. — Type: *Keysser B 28* (B, BM), New Guinea.
- Polypodium subundulatum* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 12 (1913) 180. — *Pleopeltis subundulata* Alderw., Malayan Ferns Suppl. (1917) 379. — *Crypsinus subundulatus* Copel., Gen. Fil. (1947) 207. — Type: *Keysser 82* (B), New Guinea.
- Polypodium petiolatum* Ridl., Trans. Linn. Soc. London 9 (1916) 260, nom. illeg., non Dav. (1894). — Type: *Boden Kloss s.n.* (BM), New Guinea.
- Pleopeltis renifera* Ridl., Trans. Linn. Soc. London 9 (1916) 263; Alderw., Malayan Ferns Suppl. (1917) 525; Gepp in Gibbs, Arfak Flora (1917) 75 ('*remigerum*'); Alderw., Nova Guinea 16 (1924) 38 ('*remigera*'). — Type: *Boden Kloss s.n.* (K), New Guinea.
- Pleopeltis rupestris* T. Moore var. *subalbula* Alderw., Malayan Ferns Suppl. (1917) 387. — Type: *J.J. Smith & Rant 37* (BO), Java.
- Polypodium kamboranganum* C. Chr., Gard. Bull. Str. Settle. 7 (1934) 306. — *Selliguea kamborangana* M.G. Price, Contr. Univ. Michigan Herb. 16 (1987) 198. — Type: *Holtum 25543* (BM, SING), Borneo.
- Polypodium lamprophyllum* C. Chr., Brittonia 2 (1937) 311. — *Crypsinus lamprohyllus* Copel., Gen. Fil. (1947) 207. — Type: *Brass 4558* (BM, BO, NY), New Guinea.
- Crypsinus spatulatus* Gilli, Ann. Nat. Mus. Wien 81 (1978) 21. — Type: *Gilli 375* (W), New Guinea.

Rhizome 2–4 mm thick, internodes to 1 cm long or slightly longer. Vascular strands with bundle sheath hyaline or partially sclerified; sclerenchyma strands very many. **Rhizome scales** peltate, spreading, 2.5–5 by 0.5–1 mm wide, acute, brown, evenly coloured or with a slightly lighter margin, short-dentate to strongly dentate. **Fronde** simple, monomorphic. Stipe 2–25 cm long; lamina 4–30 by 1.2–8 cm or longer, index 3.7–10, widest at 0.2–0.5 from base. **Venation**: main veins on upper surface raised, distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes mostly frequent, calcareous scales not persistent, or rarely persistent. Margin cartilaginous, thickened; notches absent or rarely sporadically present. **Sori** round or occasionally confluent within one areole, in 2, or occasionally in 3 or more irregular rows between adjacent veins, in 5 or more rows between costa and margin, 2(–3) mm wide, superficial. — **Fig. 29a, 30b.**

Distribution — Indochina. Throughout *Malesia*.

Habitat — Epiphytic, rarely epilithic on trunks or branches, terrestrial or on rocks, in a variety of forest types. Altitude 280–3500 m.

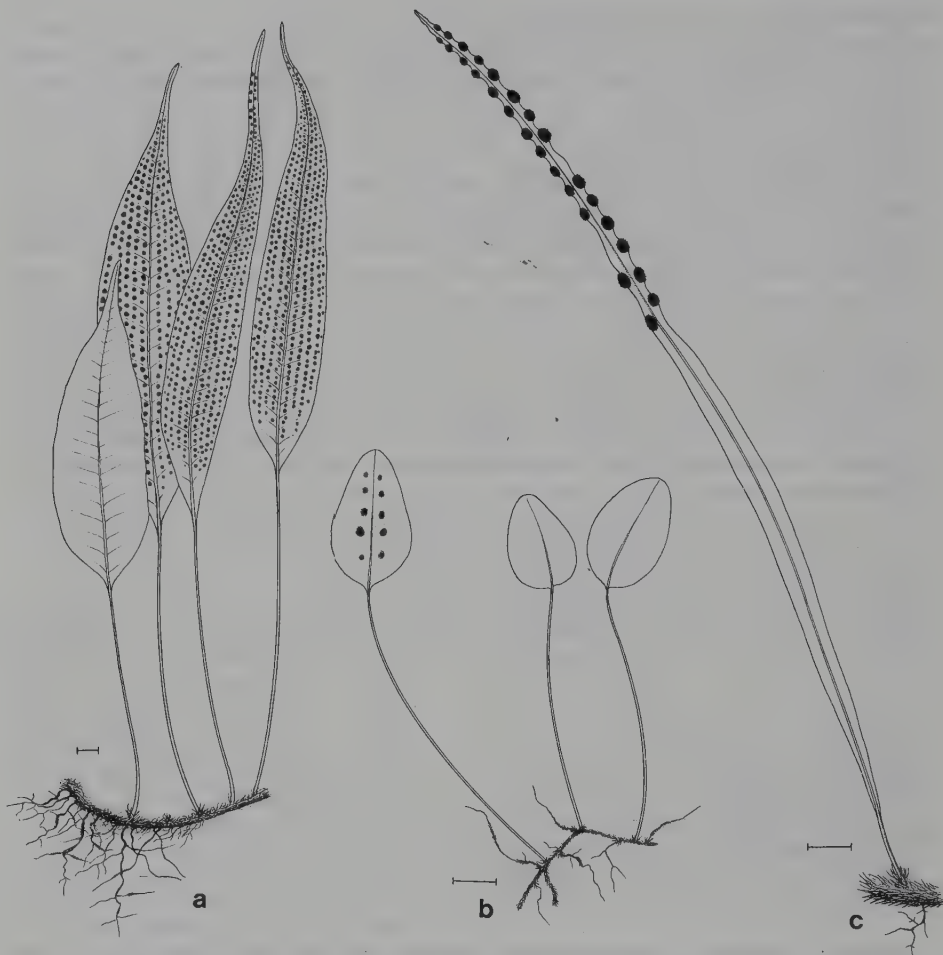


Fig. 29. *Seliguela enervis* (Cav.) Ching. a. Habit. — *S. oodes* (Kunze) Hovenkamp. b. Habit. — *S. soridens* (Hook.) Hovenkamp. c. Fertile frond. — Scale bars = 1 cm. Drawings by J. Wessendorp. Reproduced from *Blumea* 43 (1998).

Notes (on variability): 1. *Seliguela enervis* is a very variable species, presenting a different aspect and pattern of variability in different areas:

Java, Sumatra, Peninsular Malaysia, Lesser Sunda Islands

Usually large plants. Rhizome thick, scales dentate. Fronds virtually monomorphic, usually wide, ovate. Hydathodes mostly present, without persistent calcareous scales, sometimes very obscure or absent, margin not or only sporadically notched. Sori in 2 or 3 rows between veins, usually in many rows between costa and margin.

Philippines

Plants more slender generally. Rhizome 1.5–2.5 mm thick, rhizome scales 3–4.5 by 0.5–0.7 mm, remotely and weakly dentate to short-dentate. Fronds weakly dimor-

phic. Fertile fronds: stipe 2.5–10 cm long; lamina 7–12 by 1.1–2.3 cm, index 0.9–11. Sterile fronds: stipe 0.5–5.5(–21) cm long; lamina 3–8(–18.5) by 1.6–2.8(–4.8) cm, index 1.5–4.4. Hydathodes absent. Margin notches regularly present.

Borneo

Rhizome more widely creeping, 2.5–3 mm thick, internodes to 1.1–5 cm long. Rhizome scales 5.5–6 by 1.2–1.3 mm, short-dentate. Fertile fronds: stipe 3–24 cm long, lamina 7–23 by 1.8–5.8 cm, index 2.7–5.6, widest at 0.3–0.6 from base. Sterile fronds: stipe 2–13 cm long, lamina 7.5–13 by 2.6–4.6 cm, index 2.5–3.7. Hydathodes absent. Margin without notches or notches sporadically present, rarely notches regularly present.

Polypodium kaboranganum was described on the basis of a specimen with fronds strongly dimorphic, the fertile ones with a single row of sori between costa and margin, hydathodes and marginal notches regularly present.

Sulawesi

Several more or less distinct forms occur in Sulawesi, often represented by few specimens or by a single aberrant specimen. There is relatively much variation in the rhizome scales.

Some of the more constant forms are:

- a) Rhizome 1.5–2 mm, long-creeping, internodes to 1.5–3.5 cm long. scales peltate, 3.5–5.5 by 0.4–1 mm, straw-coloured to brown (often mottled), remotely and weakly dentate to short-dentate. Hydathodes absent or sometimes present. Margin notches sporadically to regularly present.
- b) Rhizome 1.5–2 mm thick, short-creeping, internodes to 0.7–1 cm long. Rhizome scales pseudopeltate or peltate, 5–7 by 1–1.5 mm, acute to contracted to a narrow acumen, whitish to straw-coloured (sometimes brown), evenly coloured, often with a dull, thickened pseudocosta, remotely and weakly to short-dentate; acumen almost entire. Hydathodes absent. Margin notches regularly present.
- c) Rhizome 2.5–4 mm thick, short-creeping, internodes to 0.5–0.8 cm long. Rhizome scales pseudopeltate to peltate, spreading to squarrose, 4.5–7 by 0.5–0.8 mm, acute or contracted to a narrow acumen, straw-coloured to brown, remotely and weakly dentate to short-dentate. Hydathodes absent. Margin notches sporadically to regularly present.

New Guinea

In New Guinea and the neighbouring islands there is an almost continuous range from large plants with a wide lamina to narrow, gramineous forms. In virtually all intermediates the presence of hydathodes and marginal notches is variable. As a consequence, forms that in other areas are distinguishable form a continuum here which cannot be divided. Transitional specimens with fronds of two different forms on a single rhizome sometimes occur.

The following names have been applied to forms in this area.

Polypodium reniferum (and, erroneously, *P. taeniophyllum*) to forms with long, gramineous fronds of less than 2 mm wide.

Polypodium induratum to forms with long, narrow (sometimes very narrow) fronds with a single row of sori between costa and margin, usually without hydathodes.

More distinctly dimorphic forms have often been identified as *Crypsinus senescens*, but the type of that is barely dimorphic. The name *C. spathulatus* better applies to these dimorphic forms.

Crypsinus subundulatus, *C. undulato-sinuatus* and *C. lamprophyllus* to somewhat wider forms, with 1 or 2 rows of sori between the costa and the margin, and an often strongly but irregularly sinuate lamina margin. The differences between these forms and those called *C. senescens* are gradual.

Polypodium petiolatum to specimens with a wider lamina, not or slightly dimorphic fronds, with 4 or 5 rows of sori between costa and margin. Hydathodes are frequent. This more or less forms a transition to *S. hellwigii*, which, however, differs in the constantly strongly dimorphic fronds.

Polypodium rhomboideum Brause (non Blume) to small, barely dimorphic specimens. They are superficially similar to *S. oodes* from the Philippines, and sometimes difficult to distinguish from true *S. oodes*.

A few specimens have been found with densely hairy fronds, but in no other way distinct from regular *Selliguea enervis*. Within *Selliguea*, hairiness is an exceptional character, occurring regularly only in a few species from continental Asia.

2. Specimens belonging to the following two species have frequently been misidentified as *S. enervis*:

Selliguea ceratophylla can be distinguished by the short rhizome and the pseudopeltate, small scales.

Selliguea pampolycarpa can be distinguished by the more closely set, long, spatulate fronds with two distinct ridges running along the upper surface of the costa.

17. *Selliguea feei* Bory

Selliguea feei Bory, Dict. Class. d'Hist. Nat. (1825) pl. 41; Blume, Enum. Pl. Javae (1828) Addenda; Fl. Javae Filic. (1829) 123; C. Presl, Epim. Bot. (1851) 145; J. Sm., Hist. Fil. (1875) 102; Copel., Gen. Fil. (1947) 209; Fern Fl. Philipp. (1960) 507; Hovenkamp, Blumea 43 (1998) 27. — *Polypodium feei* Mett., Farngatt. I. Polypodium (1856) 110; Alderw., Malayan Ferns (1908) 675; Backer & Posth., Varenfl. Java (1939) 199. — *Pleopeltis feei* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12; Malayan Ferns Suppl. (1917) 405. — Type: *Leschenault s.n.* (P), Java.

Grammitis vulcanica Blume, Enum. Pl. Javae (1828) 118 (corrected in Addenda to *Selliguea feei*). — *Polypodium feei* Mett. var. *vulcanicum* Alderw., Malayan Ferns (1908) 676. — *Pleopeltis feei* Alderw. var. *vulcanica* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12. — Type: *Blume s.n.* (L), Java.

Rhizome 3–8 mm thick, internodes to 1–4.5 cm long; vascular strands with bundle sheath fully sclerified; sclerenchyma strands absent. **Rhizome scales** peltate (rarely pseudopeltate), appressed to spreading (more often), 5–6.5 by 1.5–2.5 mm, obtuse to acute (mostly), brown, evenly coloured, entire to (rarely) remotely and weakly dentate. **Fronds** simple, dimorphic. Fertile fronds with stipe 4–30(–55) cm long; lamina 7–25 by 2–7 cm, index 3.1–7.7, widest at 0.3–0.5 from base. Sterile fronds with stipe 2.5–45 cm long; lamina 5–31 by 2–10 cm, index 2.2–2.8, widest at 0.2–0.4 from base. **Venation**: main veins on upper surface not raised to raised, distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened; without notches or

notches sporadically present. *Sori* mostly confluent across connecting veins into interrupted transverse coenosori, in one row between adjacent main veins, 3–5 mm wide, superficial.

Distribution — *Malesia*: Sumatra, Java, Lesser Sunda Islands.

Habitat — Epiphytic or epilithic; in forest, in open heath, between rocks, on cliffs, roadsides etc. Especially abundant near craters, where it is one of the few plants resistant to volcanic fumes. Altitude 900–3150 m.

Notes — 1. *Selliguea feei* is here taken in a restricted sense. It is part of an close-knit aggregate of mainly allopatric species: *S. feei*: Sumatra to Flores. – *S. elmeri*: Luzon. – *S. caudiformis*: Philippines, Celebes, Moluccas. – *S. feeoides*: Vanuatu to Pacific. – *S. plantaginea* and related species (see under *S. plantaginea*): New Guinea to Pacific. – Intermediate forms may be found between any two of these species. The differences between *S. feei* and each of these species are discussed under the separate species.

2. Specimens from Flores often have regularly trilobed fronds, a regularly notched margin and sclerenchyma strands in the rhizome. Similarly trilobed forms occur sporadically in Java, but are much more rare, and with a much lower proportion of trilobed fronds per collection.

3. Rarely the sori are interrupted, and very rarely fertile fronds have a distinct row of costal sori, as in *S. caudiformis*.

18. *Selliguea ferrea* (Brause) Hovenkamp

Selliguea ferrea (Brause) Hovenkamp, Blumea 43 (1998) 43. — *Polypodium ferreum* Brause, Bot. Jahrb. Syst. 56 (1920) 197. — *Grammatopteridium ferreum* C. Chr., Dansk Bot. Ark. 6 (1929) 81. — *Oleandropsis ferrea* Copel., Univ. Calif. Publ. Bot. 18 (10) (1942) 226; Gen. Fil. (1947) 208. — Type: *Ledermann 8881* (B), New Guinea.

Rhizome 3.5–4 mm thick, internodes variable (see note). Vascular strands with bundle sheath sclerified, 2 cells thick; sclerenchyma strands absent to many; sclerified sheath present. *Rhizome scales* peltate, appressed to spreading, 5.5–6.5 by 1–1.7 mm, acute, brown to blackish at base, upwards lighter, with irregular dark spots, entire or sometimes irregularly, coarsely dentate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 1–5 cm long, or virtually absent. Lamina 4.5–12 by 0.1–0.3 cm or longer, linear. Sterile fronds with stipe 0.5–1 cm long, usually indistinct, often virtually absent. Lamina 5.5–14 by 0.6–1.3 cm, index 6.7–18, widest at 0.5–0.8 from base. *Venation*: main veins on upper surface not raised to raised, distinct. Hydathodes absent. Margin not differentiated to thickened, hardly cartilaginous; notches regularly present, in fertile fronds absent to sporadically present. *Sori* in a longitudinal coenosorus, singly between costa and margin, 2 mm wide, superficial.

Distribution — *Malesia*: scattered on the mainland of New Guinea and surrounding islands.

Habitat — Epiphytic or terrestrial; often growing in moss cushions. Altitude 600–1200 m.

Note — Often a creeping, dorsiventral, sparsely leafy rhizome with long internodes terminates in a more erect, radial, densely leafy part. Similar radial shoots have also been found in *S. tafana*, as side shoots on an otherwise normal rhizome.

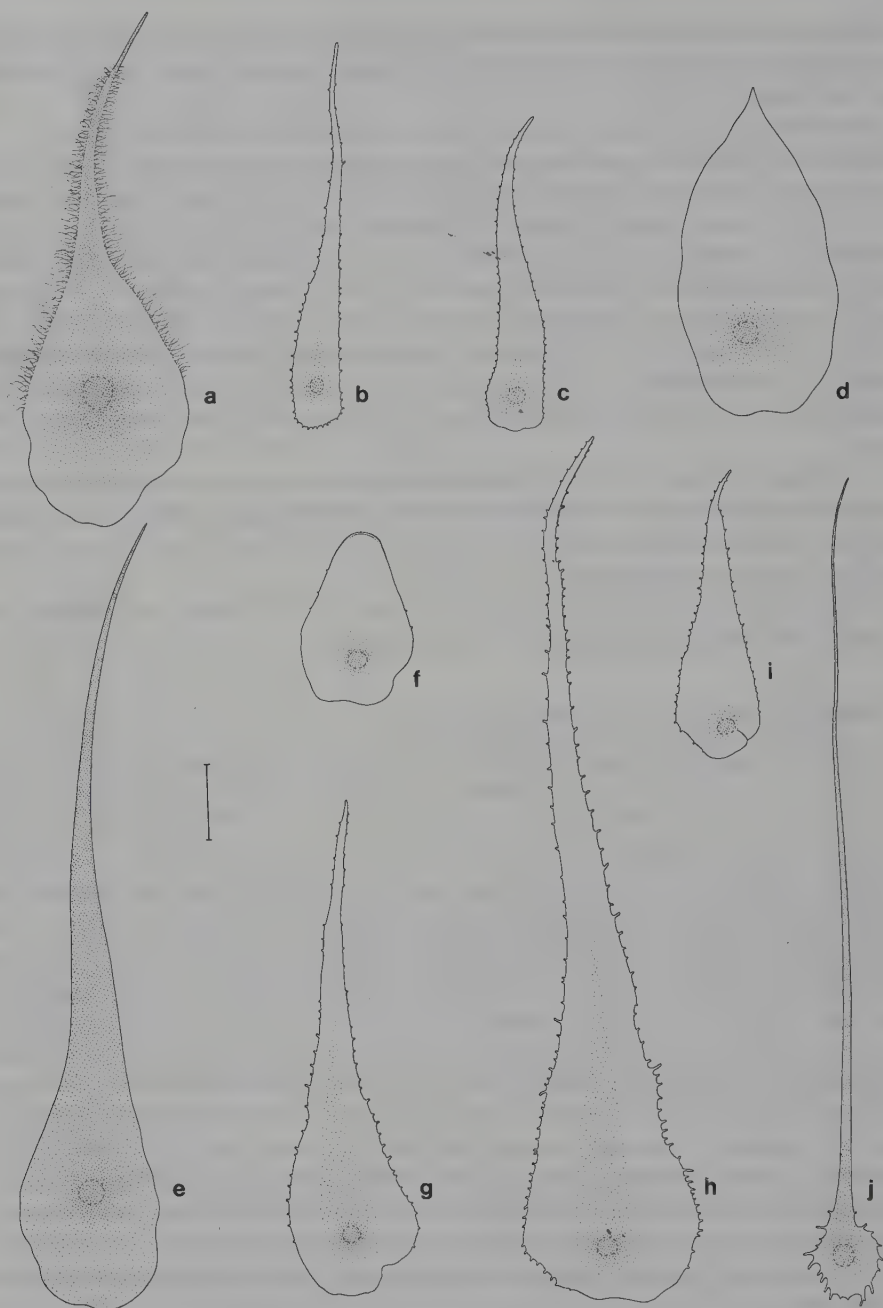


Fig. 30. *Seligeria*. Rhizome scales. — a. *S. platyphylla* (Sw.) Ching. — b. *S. enervis* (Cav.) Ching. — c. *S. bakeri* (Luerss.) Hovenkamp. — d. *S. triloba* (Houtt.) M. G. Price. — e. *S. glauca* (T. Moore) Hovenkamp. — f. *S. plantaginea* Brackenr. — g. *S. heterocarpa* (Blume) Blume. — h. *S. sri-ratu* Hovenkamp. — i. *S. ceratophylla* (Copel.) Hovenkamp. — j. *S. lateritia* (Baker) Hovenkamp. — Scale bar = 1 mm. Drawings by J. H. van Os.

19. *Selliguea glauca* (T. Moore) Hovenkamp

Selliguea glauca (J. Sm. ex T. Moore) Hovenkamp, Blumea 43 (1998) 56. — [*Drynaria glauca* J. Sm., J. Bot. (Hook.) 1 (1841) 397, nom. nud.] — *Polypodium glaucum* Mett., Farngatt. I. Polypodium (1856) 102, nom. illeg., non Thunb. (1784), Swartz (1788), Raddi (1825). — *Pleopeltis glauca* T. Moore, Index Filic. (1857) 58; II (1862) 346; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9. — *Polypodium glauco-pruinatum* C. Chr., Index Filic. (1906) 248. — Type: *Cuming* 124 (B, BM, G, K, L, P, SING), Philippines.

Drynaria glauca Brackenr. in Wilkes, U.S. Expl. Exped., Filic. 16 (1854) 54. — *Polypodium glaucum* Hook., Sp. Fil. 5 (1864) 88; Alderw., Malayan Ferns (1908) 660, nom. illeg., non Thunb. (1784), Swartz (1788), Raddi (1825), Mettenius (1857). — *Crypsinus glaucus* Copel., Gen. Fil. (1947) 206; Fern Fl. Philipp. (1960) 501; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 148. — Type: *U.S. Expl. Exped. s.n.* (n.v.), Philippines.

Rhizome 4–6 mm thick, internodes to 2.5 cm long; vascular strands with bundle sheath hyaline to fully sclerified; sclerenchyma strands many. *Rhizome scales* peltate, spreading, 9–17 by 1.5–2.2 mm, acute, brown to blackish, thick, shining, brittle, evenly coloured, entire. *Fronds* pinnatifid, monomorphic. *Stipe* 5.5–27 cm long; lamina 20–40 cm long, pinnae in 2–11 pairs, connected by a 0.2–0.4 cm wide strip; at least upper pinnae, and often also basal pinnae ascending at 45°, apical segment conspicuous, long, often the only segment fertile; largest fertile lateral pinna is 2nd to 4th from base, blade 10–19.5 by 0.9–1.5 cm, widest at 2–6 cm from base (often tapering from near pinna-base). *Venation*: main veins on upper surface not raised (rarely raised), distinct. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened to strongly thickened; notches sporadically to regularly present. *Sori* round, in one row between adjacent veins, in one row between costa and margin, at 1.5–3 mm from costa, 3 mm wide, superficial. — **Fig. 30e.**

Habitat — Epiphytic on branches and trunks, in shade as well as in exposed situations (Zamora & Co, l.c.). *Altitude* 1050–1700 m.

Distribution — *Malesia*: Philippines.

Note — Easily recognisable through the waxy rhizome, the thick, black, brittle rhizome scales and the glaucous fronds.

20. *Selliguea gracilipes* (Alderw.) Hovenkamp

Selliguea gracilipes (Alderw.) Hovenkamp, Blumea 43 (1998) 83. — *Pleopeltis gracilipes* Alderw., Nova Guinea 16 (1924) 37. — *Polypodium gracilipes* C. Chr., Index Filic. Suppl. 3 (1934) 149. — *Crypsinus gracilipes* Copel., Gen. Fil. (1947) 207. — Type: *Lam* 1798 (BO, L, UC), New Guinea.

Polypodium crassimarginatum Copel., Univ. Calif. Publ. Bot. 18 (1942) 226. — *Crypsinus crassimarginatum* Copel., Gen. Fil. (1947) 207. — Type: *Brass* 13225 (MICH, n.v.), New Guinea.

Rhizome 2–4 mm thick, internodes to 0.7–1.2 cm long; vascular strands with bundle sheath incompletely or fully sclerified; sclerenchyma strands 10–many (often little more than 10). *Rhizome scales* peltate, spreading, 5–6.5 by 1.2–1.5 mm, acute, straw-coloured to brown, evenly coloured, remotely and weakly dentate to short-dentate. *Fronds* simple, monomorphic or slightly dimorphic. Fertile fronds with stipe 1.5–9 cm long; lamina 1.4–23 by 0.4–0.7 cm, index 2–46, widest at 0.5–0.7 from base or linear. Sterile fronds: lamina 1.5–4 by 0.5–0.7 cm, index 3–6; base narrowly

cuneate, apex broadly rounded. *Venation*: main veins on upper surface not raised, indistinct. Hydathodes absent. Margin cartilaginous, strongly thickened; notches regularly to (rarely) abundantly present, in fertile fronds regularly present. *Sori* round, in two rows between adjacent veins, in one row between costa and margin, 2–3 mm wide, slightly sunken.

Distribution — *Malesia*: New Guinea.

Habitat — Terrestrial or epiphytic; often in moss cushions. Altitude 1740–3225 m.

Notes — 1. Distinct from most small species of *Selliguea* in the very thick texture, the thick cartilaginous margin, the regular presence of distinct notches, the absence of hydathodes, the rounded, not acute apex of the lamina, in which the costa ends well below the apex. *Selliguea gracilipes* is almost indistinguishable from *S. neglecta* (Sumatra, Java).

2. The stipes may be very long and slender or short and hardly distinct.

21. *Selliguea hellwigii* (Diels) Hovenkamp

Selliguea hellwigii (Diels) Hovenkamp, Blumea 43 (1998) 82. — *Polypodium hellwigii* Diels in K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1901) 140; Alderw., Malayan Ferns (1908) 645. — *Pleopeltis hellwigii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6; Malayan Ferns Suppl. (1917) 383. — *Crypsinus hellwigii* Copel., Gen. Fil. (1947) 206. — Type: *Hellwig 325a* (B), New Guinea.

Polypodium senescens Copel., Philipp. J. Sc., Bot. 6 (1911) 88. — *Pleopeltis senescens* Alderw., Malayan Ferns Suppl. (1917) 376. — *Crypsinus senescens* Copel., Gen. Fil. (1947) 207. — Type: *King 274* (B), New Guinea.

Pleopeltis obolophylla Alderw., Nova Guinea 16 (1924) 38. — *Polypodium obolophyllum* C. Chr., Index Filic. Suppl. 3 (1934) 154. — Type: *Lam 1476* (BO, L), New Guinea.

Rhizome 1 mm thick (or less), internodes to 0.5–1.2 cm long; vascular strands with bundle sheath hyaline or partially sclerified; sclerenchyma strands many. *Rhizome scales* peltate, spreading, 3–5 by 0.3–1 mm, acute, straw-coloured to brown, evenly coloured, entire. *Fronds* simple, dimorphic. Fertile fronds with stipe 0.3–4 cm long; lamina 1.5–7 by 0.3–1.2 cm, index 2.1–8.8, widest at 0.3–0.5 from base (sometimes linear); base narrowed, apex acute or sometimes acuminate. Sterile fronds with stipe 0.1–3.5 cm long; lamina 0.6–2.7 by 0.5–1.5 cm, index 0.9–4, widest at 0.2–0.5 from base; base often truncate, apex obtuse or rounded. *Venation*: costa only distinct or (occasionally) veins distinct, raised on upper surface; veinlets nearly all free, excurrent and recurrent. Hydathodes frequent (rarely absent in small specimens), calcareous scales not persistent. Margin cartilaginous, flat, usually somewhat incurved; notches regularly present. *Sori* round, two between adjacent veins (often one in small fronds), in one row between costa and margin (sometimes a few in a second row in large fronds), 2 mm wide, slightly sunken.

Distribution — *Malesia*: mainland of New Guinea.

Habitat — Low or high epiphyte, rarely epilithic or terrestrial, in forest. Altitude 100–2900 m, mostly at high altitudes.

Note — This is one of the more easily recognisable segregates from the *Selliguea enervis*-complex, which can be distinguished by the usually pronounced frond dimorphism (although nearly monomorphic plants also occur), the nearly constant pres-

ence of hydathodes (rare in the New Guinean representatives of the *S. enervis*-complex), and the flat, incurved lamina margin (usually thickened, not incurved in the *S. enervis*-complex).

22. *Selliguea heterocarpa* (Blume) Blume

Selliguea heterocarpa (Blume) Blume, Enum. Pl. Javae (1828) Addenda (correction); Fl. Javae Filic. (1829) 125; C. Presl, Epim. Bot. (1851) 146; J. Sm., Hist. Fil. (1875) 102; Ching, Bull. Fan Mem. Inst. Biol. 10 (1941) 239; Copel., Fern Fl. Philipp. (1960) 509; Kato & Price, Acta Phytotax. Geobot. 41 (1990) 72; Hovenkamp, Blumea 43 (1998) 68. — *Grammitis heterocarpa* Blume, Enum. Pl. Javae (1828) 118 (corrected in Addenda to *Selliguea*). — *Polypodium heterocarpum* Alderw., Malayan Ferns (1908) 676, nom. illeg., non Blume (1829). — *Polypodium mettenianum* Ces., Rendic. Reale Accad. Sci. Fis. (1877) 27; Backer & Posth., Varenfl. Java (1939) 198. — *Pleopeltis heterocarpa* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 12, nom. illeg., non (Blume) T. Moore; Malayan Ferns Suppl. (1917) 406. — *Selliguea metteniana* Ching, Sunyatsenia 5 (1940) 260; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 490, nom. superfl. — Type: Reinwardt s.n. (L), Java.

Polypodium morgani Zeiller, Bull. Soc. Bot. Fr. (1885) 76. — Type: *Morgan s.n.* (K, P), Malaya.

Polypodium heterocarpum var. *abbreviatum* Alderw., Malayan Ferns (1908) 676. — *Pleopeltis subcaudiformis* Alderw., Malayan Ferns Suppl. (1917) 384. — Type not indicated.

Pleopeltis schouteni Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 24; Malayan Ferns Suppl. (1917) 384. — Type: *Schouten s.n.* (BO, not traced), Java.

Polypodium papilligerum Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 13 (1914) 220. — *Pleopeltis papilligera* Alderw., Malayan Ferns Suppl. (1917) 385. — Type: *J. Winkler 67a* (UC), Sumatra.

Pleopeltis lima Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 38. — *Polypodium mettenianum* Ces. var. *lima* C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 161. — *Selliguea lima* Holttum, Revis. Fl. Malaya 2 (1954) 156. — Type: *Brooks 313/S* (BM, BO), Sumatra.

Rhizome 2–4 mm thick, phyllopods contiguous or internodes to 0.5 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands very many. **Rhizome scales** peltate, spreading, 5–8.5 by 1–1.4 mm, acute or contracted into a narrower acumen, straw-coloured to dull brown, at base consisting of thick spongy costa with a fragile, thin, narrow, translucent margin, remotely and weakly dentate at base, entire towards the apex. **Fronds** simple, dimorphic to strongly dimorphic. Fertile fronds with stipe 2–20 cm long; lamina 12–52 by 0.6–4 cm, index 6.9–32, widest at 0.4–0.6 from base or linear. Sterile fronds with stipe 0.5–14(–28) cm long. Lamina 23–37 by 0.8–6.3(–8.5) cm, index 2.9–11, widest at 0.3–0.8 from base; base and apex acuminate. **Venation**: main veins distinct, on upper surface not raised or raised. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, slightly thickened; without notches. **Sori** forming transverse coenosori (slightly elongate or round in narrow fronds) across connecting veins, single between adjacent main veins, 2–4 mm wide, slightly to (usually) deeply sunken. — **Fig. 30g.**

Distribution — Throughout *Malesia*, but rare in East *Malesia*.

Habitat — Epiphytic; in various types of forest, often growing between moss, rarely on rocks or terrestrial. Altitude mostly 1200–2000 m, much less frequent at lower or higher altitudes (200–3500 m).

Notes — 1. *Selliguea heterocarpa* has very often been confused with *S. lateritia*, with some consequential nomenclatural confusion. However, the two species are clearly distinct and differ in the following aspects:

	<i>heterocarpa</i>	<i>lateritia</i>
rhizome	short-creeping	elongated
rhizome scales	light dull brown, acumen wide, marginate	dark, often reddish, subulate, not marginate
frond base	tapering	not tapering
frond colour (dry)	dull brown	often tinged with red
coenosori	uninterrupted, deeply sunken	often interrupted, shallowly sunken

The shape of the lamina base is in most cases characteristically tapering in *S. heterocarpa*, with a wedge-shaped part more or less sharply set off as some sort of bottleneck.

2. Plants from Sumatra have more deeply sunken sori, on the upper surface forming broadly flat-topped ridges, with steep sides sharply set off from the flat top. This form has been described as *Selliguea lima*.

3. Small forms with almost rounded, deeply sunken sori, often on almost linear fertile fronds (mainly from Sumatra and Peninsular Malaysia) have been described under the names *Polypodium papilligerum* and *P. morgani*; they also have been confused with *Selliguea stenophylla*.

23. *Selliguea laciniata* (Bedd.) Hovenkamp

Selliguea laciniata (Bedd.) Hovenkamp, Blumea 43 (1998) 47. — *Polypodium laciniatum* Blume, Enum. Pl. Javae (1828) 131, nom. illeg., non Burman f. (1768), Lam. (1778), Gmelin (1791). — *Pleopeltis laciniata* Bedd., Suppl. Ferns Brit. India (1892) 97; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10; Malayan Ferns Suppl. (1917) 399. — *Phymatopsis laciniatum* J. Sm., Hist. Fil. (1875) 105; Ching, Acta Phytotax. Sin. 9 (1964) 192. — *Crypsinus laciniatus* Holttum, Revis. Fl. Malaya 2 (1954) 198. — Type: *van Hasselt s.n.* (L), Java.

Polypodium macrochasmum Baker, J. Bot. n.s. 9 (1880) 216; Alderw., Malayan Ferns (1908) 664; Backer & Posth., Varenfl. Java (1939) 219. — *Phymatodes macrochasma* Ching, Bull. Fan Mem. Inst. Biol. 10 (1941) 239. — *Crypsinus macrochasmus* Copel., Gen. Fil. (1947) 206. — *Phymatopteris macrochasma* Pichi Serm., Webbia 28 (1973) 463. — Type: *Beccari 468* (BM, BO, K, P).

Rhizome 8–13 mm thick, internodes to 1.5–2 cm long; vascular strands with bundle sheath absent; sclerenchyma strands very many. *Rhizome scales* pseudopeltate to peltate, spreading (rarely squarrose), 5–9 by 1–2 mm wide, acute, brown, evenly coloured or with a lighter margin (usually not hyaline), strongly dentate with teeth close, very long. *Fronds* pinnatifid, rarely pinnate, monomorphic; stipe 18–40 cm long; lamina 23–48 cm long, pinnae 5–11 pairs, width of connecting strip 0.1–0.5 cm; base cordate; largest pinna is 2nd–6th from base, 13–27 by 1.4–2.5 cm wide, widest at 5–10 cm, with a cusp 1–5 cm long, basal pinnae narrowed on basiscopic base or cut away to costa. *Venation*: main veins on upper surface raised, connecting veins distinct or veinlets also distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent (rarely persistent). Margin cartilaginous, thickened; notches sporadically to regularly present (mostly). *Sori* round, singly between adjacent veins, in one row between costa and margin, at 2–4 mm from costa, 3–4 mm wide, slightly to deeply sunken.

Distribution — *Malesia*: Sumatra, Pensinsular Malaysia (extending into S Thailand), Java, Lesser Sunda Islands, Moluccas? (Seram, one doubtful record). Distribution outside Malesia unknown (see note 3).

Habitat — Epiphytic, epilithic or terrestrial. On trunks or branches, on rocks and on earth banks. In forest or more open situations. Altitude 100–2500 m.

Notes — 1. Smells of coumarin when dry. The lower surface of the lamina is often noted to be distinctly glaucous in fresh material.

2. Three regional forms can be recognised, but they are not sharply distinct:

Java, Lesser Sunda Islands — Rhizome shortly creeping, internodes to 2 cm, with many sclerenchyma strands, aggregated to form a peripheral sheath (strands sometimes absent in specimens from Timor). Vascular strands without sclerified sheath. Scales pseudopeltate, densely ciliate. Base of lamina usually cordate, rarely decurrent. Sori distinctly to deeply sunken.

Sumatra — Rhizome more or less widely creeping, internodes to 3 cm, with scattered sclerenchyma strands, not or indistinctly concentrated in a peripheral sheath. Vascular strands with a sclerified sheath. Scales peltate, less densely ciliate. Base of frond more or less decurrent, margin more strongly thickened, with more distinct notches. Sori never deeply sunken.

Peninsular Malaysia, S Thailand — Rhizome more or less widely creeping, internodes to 2.5 cm. Rhizome mostly without sclerenchyma strands. Vascular strands with a sclerified sheath. Scales peltate, mainly short-dentate. Base of frond cordate but not deeply, more or less decurrent, margin strongly thickened, with distinct notches. Sori never deeply sunken.

3. *Selliguea laciniata* seems to be not clearly distinct from *Crypsinus quasidivariatus* or *C. echinosporus* from Taiwan. The distribution on the mainland of Continental Asia could not be assessed without undertaking a complete critical revision of the Chinese species.

24. *Selliguea lagunensis* (H. Christ) Hovenkamp

Selliguea lagunensis (H. Christ) Hovenkamp, Blumea 43 (1998) 55. — *Polypodium lagunense* H. Christ, Bull. Herb. Boiss. 6 (1898) 201; Alderw., Malayan Ferns (1908) 667. — *Pleopeltis lagunense* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10; Malayan Ferns Suppl. (1917) 400. — *Crypsinus lagunensis* Copel., Gen. Fil. (1947) 206; Fern Fl. Philipp. (1960) 503. — *Phymatopteris lagunense* Pichi Serm., Webbia 28 (1973) 463; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 155. — Type: *Loher 90* (K, P), Philippines, Luzon.

Rhizome 3.5–4 mm thick, internodes to 1–1.5 cm long. Vascular strands with bundle sheath hyaline, or partially sclerified; sclerenchyma strands many to very many. *Rhizome scales* peltate, spreading, 4–4.5 by 1–1.3 mm, acute, straw-coloured to brown with a lighter margin, remotely and weakly to short-dentate. *Fronds* pinnate, internally dimorphic. Fertile fronds: stipe 6.5–25 cm long; lamina 13.5–26 cm long, pinnae 5–10 (the lower pairs often wholly or partly sterile); largest fully fertile pinna, stalk up to 0.2 cm, blade 4.5–13.5 by 0.3–0.5(–1.2) cm. Sterile fronds: stipe 4.5 cm long; lamina 8 cm long; largest sterile pinna is 1st from base (usually), stalk 0.2–0.5 cm, blade 6–11 by 1.2–2.2 cm, widest at 2.5–3.5 cm, with a cusp 0.5–2.5 cm long. *Venation*: main veins on the upper surface not raised, connecting veins distinct. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened;

notches regularly present, in fertile fronds sporadically to regularly present, less distinct than in sterile parts. *Sori* round, in one row between adjacent veins, in one row between costa and margin, at 1 mm from costa, 1–2 mm wide, superficial.

Distribution — *Malesia*: Philippines.

Habitat — Epiphytic, on mossy branches at exposed ridges or summits (Zamora & Co, l.c.). Altitude 1050–1850 m.

Note — The internally strongly dimorphic fronds make this an easily recognisable species. Both fully sterile and fully fertile fronds are rare, usually at least the apical part of the apical segment is fertile, or the basal part of the basal pinnae sterile.

25. *Selliguea lateritia* (Baker) Hovenkamp

Selliguea lateritia (Baker) Hovenkamp, Blumea 43 (1998) 71. — *Polypodium lateritium* Baker, Ann. Bot. (London) 5 (1891) 93. — *Selliguea metteniana* var. *lateritium* Tardieu & C. Chr., Notul. Syst. 8 (1939) 197; in Fl. Indo-Chine 7, 2 (1941) 490. — Type: *Godefroy-Lebeuf* 862 (K), Cambodia.

Polypodium treubii H. Christ, Ann. Jard. Bot. Buitenzorg II, 5 (1905) 121; Alderw., Malayan Ferns (1908) 646. — *Pleopeltis treubii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6; Malayan Ferns Suppl. (1917) 384. — *Polypodium mettenianum* Ces. forma *treubii* C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 161. — *Selliguea treubii* Ching, Sunyatsenia 5 (1940) 260. — Type: *Hallier* 3438 (K, L), Borneo.

Polypodium taeniophyllum Copel., Philipp. J. Sc., Bot. 6 (1912) 65. — *Pleopeltis taeniophylla* Alderw., Malayan Ferns Suppl. (1917) 378. — *Crypsinus taeniophyllus* Copel., Gen. Fil. (1947) 207. — *Selliguea taeniophylla* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 152. — Type: *Native Collector* BS 769 (MICH), Sarawak.

Rhizome 1–3 mm thick, internodes to 0.5–1 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands many to very many. *Rhizome scales* rarely pseudopeltate, usually peltate, spreading or squarrose, 5.5–12 by 0.4–1 mm (width at base), from the wide base abruptly contracted to a narrow, subulate, brown acumen, at base with a lighter, irregularly lacerate/dentate margin; acumen entire. *Fronds* simple, dimorphic. Fertile fronds with stipe 3.2–25.5 cm long; lamina 5.7–21.5 by 0.7–5.1 cm, index 3–15, widest at 0.2–0.4 from base (sometimes linear). Sterile fronds with stipe 2–15.5 cm long; lamina 4.5–14 by 1–7 cm, index 1.5–6, widest at 0.2–0.6 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes absent. Margin cartilaginous, thickened, without notches. *Sori* elongate or confluent across connecting veins to transverse coenosori, in one row between adjacent main veins, in 2–5, sometimes more, rows between costa and margin, 1–4 mm wide, slightly to deeply sunken (upper surface never strongly pustulose). — **Fig. 30j.**

Distribution — Indochina (Thailand, Cambodia, southern Vietnam). *Malesia*: common in Sumatra, Peninsular Malaysia, Peninsular Thailand, Borneo (very common), sporadically in the Philippines, Sulawesi, and New Guinea.

Habitat — Epiphytic, epilithic or terrestrial. On trunks or branches, in a wide variety of forest types; often in riverbeds. Altitude from sea level to 1200 m, occasionally reaching higher, to 2000 m.

Notes — 1. *Selliguea lateritia* has been extensively confused with *S. heterocarpa*; see under that species for a discussion of the distinction.

2. *Polypodium taeniophyllum* represents an extremely narrow form, but is connected to the typical form by a series of intermediates. Plants from New Guinea have slightly thicker and stiffer scales which are not acicular and squarrose. They are more or less intermediate to *S. heterocarpa*, which seems to be absent from New Guinea.

3. *Selliguea lateritia* may be increasing in frequency, especially in Borneo, with many recent records.

26. *Selliguea lauterbachii* (Brause) Hovenkamp

Selliguea lauterbachii (Brause) Hovenkamp, Blumea 43 (1998) 41. — *Polypodium lauterbachii* Brause, Bot. Jahrb. Syst. 49 (1912) 52. — *Pleopeltis lauterbachii* Alderw., Malayan Ferns Suppl. (1917) 383. — Type: *Schlechter 18688* (B, K, P, UC), New Guinea.

Pleopeltis gibbsiae Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 37. — *Polypodium gibbsiae* C. Chr., Index Filic. Suppl. 3 (1934) 149. — Type: *Gibbs 5689* (BM, P), New Guinea.

Rhizome 2.5–3 mm thick, internodes to 2.5–3 cm long; vascular strands with bundle sheath fully sclerified; sclerenchyma strands many. *Rhizome scales* peltate, usually squarrose, sometimes spreading, 3–5.5 by 0.7–1 mm, acute, brown, with a lighter margin, strongly dentate, occasionally long-ciliate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 4–10 cm long; lamina 7–9 by 0.2–0.4 cm, linear. Sterile fronds with stipe 1–7 cm long; lamina 5–14.5 by 1–4 cm, index 2.6–9, widest at 0.3–0.4 from base. *Venation*: main veins on upper surface raised, distinct. Hydathodes absent. Margin cartilaginous, thickened; notches often present. *Sori* elongated, in one row between adjacent veins and between costa and margin, 2–3 mm wide, superficial.

Distribution — *Malesia*: Sulawesi (Rantemario), Moluccas (Tidore), New Guinea.

Habitat — Low to high epiphyte or epilithic, in forest or rarely open places, often in secondary forest or disturbed situations. Altitude (390–)1500–2500(–3200) m.

Notes — 1. *Selliguea lauterbachii* is usually easily recognisable by the narrow fertile fronds with separate sori, and the usually squarrose, strongly dentate, brown rhizome scales. It can be similar to forms of *S. plantaginea*, *S. costulata* and *S. tafana*. Some specimens have fronds that are intermediate to *S. plantaginea*, gradually narrowed from a wide, sterile base to a narrow, fertile apex.

Selliguea costulata frequently has interrupted coenosori, thus blurring the distinction from *S. lauterbachii*. *Selliguea tafana* can be distinguished by the blackish rhizome scales which are less strongly dentate, the relatively short fertile fronds, and the frequent occurrence of small scales on the fronds. It usually occurs at higher altitudes than *S. lauterbachii*, but especially sterile specimens from the intermediate range cannot always be identified.

2. In very narrow fronds the coenosori are elongated longitudinally, in somewhat wider fronds they are distinctly oblique, directed towards the margin, forming a transition to *S. plantaginea*.

27. *Selliguea metacoela* (Alderw.) Parris

Selliguea metacoela (Alderw.) Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu.

I. Ferns and fern allies (1991) 152; Hovenkamp, Blumea 43 (1998) 90. — *Drymoglossum metacoelum* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 21. — *Pycnoloma metacoelum* C. Chr., Dansk Bot. Ark. 6 (1929) 77. — Type: *Hallier 2942* (L), Borneo.

Rhizome 2 mm thick, internodes to 0.4–0.8 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands few. *Rhizome scales* pseudopeltate, spreading, 4–5.5 by 0.6 mm, acute, straw-coloured, or brown; acumen dull light-brown; base darker; margin remotely and weakly dentate at base, entire in acumen. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 5.5–11 cm long; lamina 3–8 by 0.2–0.3 cm, linear. Sterile fronds with stipe 0.3–2 cm long; lamina 1–2.5 by 1–1.7 cm, index 1–2.1, widest at 0.3–0.5 from base. *Venation*: costa only distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin cartilaginous, thickened to strongly thickened; without notches. *Sori* confluent across veins into a longitudinally elongated coenosorus, a single one between costa and margin, superficial.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Borneo.

Habitat — Epiphytic; no further data. Altitude 150–800 m.

Note — *Selliguea rigida* is generally more stiff, with thick rhizome scales and an extremely thickly coriaceous lamina, and with distinctly sunken coenosori.

28. *Selliguea murudensis* (C. Chr.) Parris

Selliguea murudensis (C. Chr.) Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu.

I. Ferns and fern allies (1991) 152; Hovenkamp, Blumea 43 (1998) 94. — *Pycnoloma murudense* C. Chr., Dansk Bot. Ark. 6 (1929) 78; Gard. Bull. Str. Settle. 7 (1934) 310. — Type: Mjöberg 1923 (BM), Borneo.

Rhizome 1–2 mm thick, internodes to 0.5–1 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands many, mainly central. *Rhizome scales* peltate, spreading, 2.9–4.5 by 0.7–1 mm, acute, brown, evenly coloured or with a slightly lighter margin, remotely and weakly to short-dentate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 6.5–18 cm long; lamina 9–15.5 by 0.2–0.25 cm, linear. Sterile fronds with stipe 2–7 cm long; lamina 2–5.5 by 1.6–2.5 cm, index 1.2–3.4, widest at 0.1–0.5 from base; base cuneate to truncate, apex rounded. *Venation*: main veins on upper surface raised, distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes sometimes present to frequent, calcareous scales not persistent. Margin cartilaginous, thickened to strongly thickened; notches regularly present, absent in fertile fronds. *Sori* longitudinally elongate or confluent across veins, forming a longitudinal coenosorus, a single one between costa and margin, 1 mm wide, superficial.

Distribution — *Malesia*: North Borneo.

Habitat — As epiphyte both on trunks or branches; also epilithic. Altitude 150–1700 m.

Notes — 1. *Selliguea murudensis* can be confused with *S. brooksii* and *S. pseudoacrostichum*. It differs from *S. brooksii* in its usually smaller, slenderer stature, the lamina base usually more narrowly cuneate, lamina surfaces not distinctly glandular (inconspicuous glands may be present), with conspicuous hydathodes always at least a few present. From *S. pseudoacrostichum* it differs in mostly shorter internodes, narrower fertile fronds and continuous or nearly continuous coenosori.

2. The coenosori are occasionally interrupted.

29. *Selliguea neglecta* (Blume) Hovenkamp

Selliguea neglecta (Blume) Hovenkamp, Blumea 43 (1998) 88. — *Polypodium neglectum* Blume, Enum. Pl. Javae (1828) 121; Fl. Javae Filic. (1829) 133. — *Drynaria neglecta* J. Sm., J. Bot. (Hook.) 3 (1841) 397. — *Microterus neglectus* C. Presl, Epim. Bot. (1851) 124. — *Niphobolus neglectus* Fée, Gen. Filic. (1850-1852) 264. — *Craspedaria calva* Fée, Gen. Filic. (1850-1852) 265, nom. illeg. — *Pleopeltis neglecta* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — Type: Kuhl & van Hasselt s.n. (BO), Java.

Pleopeltis parvifrons Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 165; Bull. Jard. Bot. Buitenzorg III, 5 (1922) 216. — *Polypodium parvifrons* C. Chr., Index Filic. Suppl. 3 (1934) 155. — Type: Bunnemeijer 4707 (BO, L), Sumatra.

Rhizome 1–2 mm thick, internodes to 0.4–0.7 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands few. *Rhizome scales* peltate, spreading, 1.4–2.8 by 0.4–0.6 mm, acute, brown, evenly coloured, strongly dentate. *Fronds* simple, mono- to dimorphic. Fertile fronds with stipe (1–)2.5–3.5(–6.5) cm long; lamina 2–7 by 0.3–0.8 cm, index 4–17, widest at 0.4–0.9 from base or linear. Sterile fronds with stipe 0.5–3.5 cm long; lamina 1.3–4 by 0.7–1.7 cm, index 1.6–5, widest at 0.4–0.7 from base or linear; apex rounded. *Venation*: costa only distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin cartilaginous, flat to thickened; notches regularly present, in fertile fronds sometimes fewer. *Sori* round, in one row between adjacent veins, in one row between costa and margin, 2–3 mm wide, superficial.

Distribution — *Malesia*: Sumatra, Java.

Habitat — Epiphytic; in forest. Altitude 1440–2560 m.

Note — *Selliguea neglecta* can be confused with forms of *S. subsparsa*, from which it can be distinguished only with difficulty: *Selliguea neglecta* has the sori singly between the veins, *S. subsparsa* usually has two sori between each pair of veins. As the venation is rarely visible, the position of the veins is best inferred from the position of the marginal notches.

30. *Selliguea oodes* (Kunze) Hovenkamp

Selliguea oodes (Kunze) Hovenkamp, Blumea 43 (1998) 89. — *Polypodium oodes* Kunze, Bot. Zeitung (Berlin) 4 (1846) 421; Hook., Sp. Fil. 5 (1864) 71; Baker, Syn. Fil. (1868) 354; Alderw., Malayan Ferns (1908) 652. — *Pleopeltis oodes* T. Moore, Index Filic. (1857) 67; II (1862) 347; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7; Malayan Ferns Suppl. (1917) 390. — *Phymatopsis oodes* J. Sm., Hist. Fil. (1875) 105. — *Crypsinus oodes* Copel., Gen. Fil. (1947) 207; Fern Fl. Philipp. (1960) 506. — Type: Cuming 58 (BM, BO, K, L, P, PRC), Philippines. *Polypodium dulitense* Baker, Kew Bull. (1893) 211; Alderw., Malayan Ferns (1908) 652. — *Pleopeltis dulitensis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7; Malayan Ferns Suppl. (1917) 390. — Type: C. Hose 300 (K, SING), Borneo.

Polypodium rudimentum Copel. in Perkins, Fragm. Fl. Philipp. 1 (1905) 190. — *Pleopeltis rudimenta* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5. — Type: Elmer 6022 (B, K, P), Philippines, Luzon.

Rhizome 0.5–1 mm thick, internodes to 0.7–2 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands absent. *Rhizome scales* peltate, spreading, 2.5–4.5 by 0.5 mm, acute, straw-coloured or brown, thin, translucent, evenly coloured, entire or remotely and weakly dentate, usually more strongly lacerate-dentate at the base. *Fronds* monomorphic. Stipe 0.4–10 cm long, usually very thin. Lamina

1–8 by 1–2.5(–3.6) cm, index 0.7–3.5, widest at 0.2–0.6 from base. Base rounded to cordate, occasionally cuneate, apex rounded to acuminate. *Venation*: costa only distinct; veinlets free or anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened; notches regularly present. *Sori* round, elongate, confluent within one areole or across connecting veins, in one or two rows between adjacent veins, in 1–4 rows between costa and margin, 1–2 mm wide, slightly sunken to deeply sunken. — **Fig. 29b.**

Distribution — *Malesia*: Philippines, Borneo, Sulawesi.

Habitat — Epilithic, rarely epiphytic. Mostly as a rheophyte in riverbeds, sometimes on tree trunks. Altitude 600–1500 m.

Notes — 1. *Selliguea oodes* can be confused with small forms of the *S. enervis*-complex ('*Polypodium rhomboideum*'). The distinctly sunken sori, the soft, succulent texture, the presence of hydathodes and the angle between lamina and stipe will usually distinguish *S. oodes*.

2. *Polypodium dulitense* represents a form with lobed or sinuose margins and an acuminate apex.

31. *Selliguea pampolycarpa* (Alderw.) Hovenkamp

Selliguea pampolycarpa (Alderw.) Hovenkamp, Blumea 43 (1998) 87. — *Pleopeltis pampolycarpa* Alderw., Nova Guinea 16 (1924) 37. — *Polypodium pampolycarpum* C. Chr., Index Filic. Suppl. 3 (1934) 155. — Type: *Lam 1254* (BO, L), New Guinea.

Rhizome 1.5–2.5 mm thick, internodes to 0.2–0.5 cm long. Vascular strands with bundle sheath hyaline or partially sclerified. Sclerenchyma strands many. *Rhizome scales* peltate, spreading to slightly squarrose, 7.5–8.5 by 1 mm, acute or slightly contracted to a narrow acumen, brown, evenly coloured, entire or remotely and weakly dentate. *Fronds* simple, mono- to dimorphic. Fertile fronds with stipe 2–10 cm long; lamina 17–34 by 0.7–1.3 cm, widest at 0.5–0.8 from base. Sterile fronds with stipe 1.5–5 cm long; lamina 10–21 by 1.6–2.2 cm, index 5.5–8.1, widest at 0.5–0.8 from base; base very gradually narrowed. *Venation*: costa distinct, with two very distinct ridges on upper surface, main veins sometimes distinct, not raised on upper surface. Hydathodes absent. Margin not differentiated or cartilaginous, thickened; notches sporadically to regularly present. *Sori* round, in two rows between adjacent veins, in 2–4 rows between costa and margin, 1.5–3 mm wide, superficial to slightly sunken.

Distribution — *Malesia*: New Guinea.

Habitat — Epiphyte on trunks and branches, in forest. Altitude 100–820 m.

Note — Apparently a rare species, but easily overlooked and confused with narrow forms of *Selliguea enervis*. The short internodes, the long, spatulate fronds which are very gradually narrowed into, usually, a short indistinct stipe, but particularly the distinct ridges on the upper side of the costa are characteristic. In many collections the apex of the long fronds is missing.

32. *Selliguea plantaginea* Brackenr.

Selliguea plantaginea Brackenr. in Wilkes, U.S. Expl. Exped., Filic. 16 (1854) 58; Hovenkamp, Blumea 43 (1998) 33. — Type: *U.S. Expl. Exped. s.n.* (K), Tahiti.

- Polypodium wernerii* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 5 (1908) 43; Alderw., Malayan Ferns (1908) 649. — *Pleopeltis wernerii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7; Malayan Ferns Suppl. (1917) 386. — *Polypodium wernerii* C. Chr., Brittonia 2 (1937) 312. — *Selliguea wernerii* Pichi Serm., Webbia 31 (1977) 249. — Type: *Werner 75* (B, UC), New Guinea.
- Polypodium alloiosorum* Brause, Bot. Jahrb. Syst. 56 (1920) 202. — *Selliguea alloiosora* Ching, Sunyatsenia 5 (1940) 260. — Type: *Ledermann 12575* (B), New Guinea.
- Polypodium mafuluense* C. Chr., Brittonia 2 (1937) 313. — Type: *Brass 5204* (BM, NY), New Guinea.
- Crypsinus caudaeifolius* Gilli, Ann. Nat. Mus. Wien 81 (1978) 21. — Type: *Gilli 334* (W), New Guinea.

Rhizome 1.5–8 mm thick, internodes 1–6 cm long; vascular strands with bundle sheath sclerified, to 2 cells thick; sclerenchyma strands absent to many. **Rhizome scales** peltate, appressed to spreading, 2–8.5 by 1–2.6 mm, obtuse, acute or contracted to a narrow acumen, apex flat or distinctly cucullate, straw-coloured to brown, evenly coloured, mottled or with a darkened apex, entire to strongly dentate (often coarsely and irregularly). **Fronds** simple, dimorphic. Fertile fronds with stipe 1.5–23 cm long; lamina 4–28 by 0.8–5.3 cm, index 2.7–10, widest at 0.2–0.5 from base. Sterile fronds with stipe 1–20 cm long; lamina 3–30 by 0.9–10 cm, index 1.6–6.4 widest at 0.2–0.5 from base. **Venation**: main veins on upper surface not raised, indistinct, or raised, distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin not or hardly differentiated, without notches or notches sometimes regularly present. **Sori** round, elongate or confluent across connecting veins to coenosori, in one row between adjacent main veins (rarely two rows, near the costa at the base of the lamina), in 2–many rows between costa and margin, 3–4 mm wide, superficial to slightly sunken. — **Fig. 30f.**

Distribution — *Malesia*: Sulawesi, New Guinea; Pacific Islands.

Habitat — Usually epiphytic, mostly in summit forest, occasionally terrestrial, in swamps or on banks, also in alpine grasslands. Altitude 180–3840 m.

Notes — 1. *Selliguea plantaginea* is the most widely spread New Guinean/Pacific representative of the complex of mainly allopatric species around *S. feei*, to which also belong *S. elmeri* (Philippines), *S. caudiformis* (East Malesia) and *S. feeoides* (Pacific). Within this complex, the species boundaries are rarely sharp. From *S. feei*, *S. caudiformis* and *S. feeoides*, the present species differs mainly in the absence of hydathodes. At the same time, *S. plantaginea* is the central species in a complex of mainly sympatric species, in which specific boundaries are occasionally even less clear: *S. albicaula*, *S. archboldii*, *S. bellisquamata*, *S. costulata*, *S. cretifera*, *S. de-kockii*, *S. ferrea* (*Oleandropsis ferrea*), *S. lauterbachii* (used to be called '*gibbsiae*'), *S. tafana* (often identified as '*squamisora*').

2. The species is very variable in the degree to which the sori are confluent.

3. Throughout the mountain ranges of New Guinea two forms occur. One has fairly thick rhizomes, densely set with spreading, elongated, acute scales which are dark near the attachment and lighter coloured in the acumen; usually found at altitudes up to 2700 m. The other form has usually thinner rhizomes (1.5–3 mm), strongly glaucous, and sparsely set with deciduous, appressed, obtuse scales often with a darker, thickened, distinctly cucullate apex. It is almost exclusively restricted to heights of over 3000 m. Apart from the rhizomes, the two forms are indistinguishable in many

locations, exhibiting the same variation in frond shape, size and soral disposition. Moreover, over a fairly wide altitudinal range (2400–3400 m), specimens are occasionally found which combine characters of the two forms, often on different parts of the same rhizome.

33. *Selliguea platyphylla* (Sw.) Ching

Selliguea platyphylla (Sw.) Ching, Bull. Fan Mem. Inst. Biol. 1 (1941) 238; Hovenkamp, Blumea 43 (1998) 64. — *Polypodium latifolium* Poir., Enc. Meth. Bot. (1804) 512, nom. illeg., non Forster (1786). — *Polypodium platyphyllum* Sw., Syn. Fil. (1806) 27; Baker, Syn. Fil. (1868) 359; Alderw., Malayan Ferns (1908) 647; Backer & Posth., Varenfl. Java (1939) 197. — *Pleopeltis platyphylla* Bedd., Suppl. Ferns Brit. India (1892) 94; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7; Malayan Ferns Suppl. (1917) 386. — *Crypsinus platyphyllus* Copel., Gen. Fil. (1947) 207; Holttum, Revis. Fl. Malaya 2 (1954) 198. — Type: *Commerson s.n.* (P, US), Java.

Polypodium crassinervium Blume, Enum. Pl. Javae (1828) 125; Fl. Javae Filic. (1829) 145 (non *P. crassinerve* Schumacher 1827). — *Pleopeltis crassinervium* T. Moore, Index Filic. (1857) 58. — *Pleuridium crassinervium* J. Sm., Ferns Brit. & For. (1866) 95; Hist. Fil. (1875) 95. — Type: *Reinwardt s.n.* (L), Moluccas.

Rhizome 3–10 mm thick, internodes to 1–2.5 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands very many. **Rhizome scales** peltate, spreading to squarrose, recurved from an appressed base, 7.5–10 by 1.2–2.1 mm (width at base), contracted to a narrow acumen, brown to blackish, very stiff, brittle, with a lighter margin, long-ciliate on margin and exposed surfaces, cilia often absent from older scales. **Fronds** simple, monomorphic. Stipe 2–30 cm long; lamina 6.5–60 by 1.7–12 cm, index 3–6.5, widest at 0.3–0.5 from base. **Venation**: main veins on upper surface very distinct, not raised or raised. Hydathodes frequent, calcareous scales persistent, large, conspicuous. Margin cartilaginous, strongly thickened; notches regularly present. **Sori** round, in one row between adjacent veins, in 5–11 rows between costa and margin, 2 mm wide, deeply sunken. — **Fig. 30a.**

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Java, Borneo.

Habitat — Epiphytic, epilithic or terrestrial. In forest, plantations, roadsides etc. Altitude from sea level to 1500 m.

34. *Selliguea pseudoacrostichum* (Alderw.) Hovenkamp

Selliguea pseudoacrostichum (Alderw.) Hovenkamp, Blumea 43 (1998) 94. — *Pleopeltis pseudoacrostichum* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 36. — *Polypodium pseudoacrostichum* C. Chr., Index Filic. Suppl. 3 (1934) 156. — Type: *Bünnemeijer 830* (BO), Sumatra.

Polypodium pyrolaefolium Goldm. var. *sumatrana* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 13 (1914) 220. — Type: *Winkler 125* (K, UC), Sumatra.

Rhizome 2 mm thick (dorsoventrally flattened), internodes to 1.5–2 cm long; vascular strands with bundle sheath hyaline or partially sclerified; sclerenchyma strands many, sclerified sheath present. **Rhizome scales** peltate, appressed to spreading, 4–5.5 by 1 mm, acute, straw-coloured or brown with a lighter margin, sometimes with irregular dark spots, remotely and weakly dentate. **Fronds** simple, strongly dimorphic. Fertile fronds with stipe 8–14 cm long; lamina 3.5–10 by 0.3–0.6 cm, index 9–12,

widest at 0.4–0.5 from base or linear. Sterile fronds with stipe 0.8–6.5 cm long; lamina 2.5–5 by 0.9–2.7 cm, index 1.4–3.7, widest at 0.2–0.5 from base. *Venation*: main veins on upper surface raised, distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, relatively large and conspicuous, calcareous scales not persistent. Margin cartilaginous, thickened; notches regularly present. *Sori* round, in two rows between adjacent veins, often confluent to a longitudinally elongated sorus, in one row between costa and margin (occasionally a few sori in a second row), 1.5–2 mm wide, superficial.

Distribution — *Malesia*: Sumatra.

Habitat — Epiphytic; in mossy forest. Altitude 1200–2000 m.

Notes — 1. Very similar to *Selliguea murudensis* from Borneo, from which it differs in the fertile lamina being usually over 3 mm wide with a distinct sterile margin, and in the sori, which may be longitudinally elongated but usually not confluent across the veins.

2. Some specimens have light-coloured, appressed rhizome scales with a finely dentate, scarious margin; others have more brownish, spreading scales.

3. *Crypsinus hagerupii* differs in a much more coriaceous texture, and lack of hydathodes. It is insufficiently known, no other specimens than the type specimen (*Hagerup s.n.*, 1916/17, Lake Toba, BM) could be found.

35. *Selliguea pyrolifolia* (Goldm.) Hovenkamp

Selliguea pyrolifolia (Goldm.) Hovenkamp, Blumea 43 (1998) 58. — *Polypodium pyrolaeifolium* Goldm., Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. (1843) 453. — *Crypsinus pyrolifolius* Copel., Gen. Fil. (1947) 206; Fern Fl. Philipp. (1960) 503. — Type: *Meyen s.n.* (n.v.), Philippines ('Manila').

[*Marginaria nummularia* C. Presl, Tent. Pterid. (1836) 188, nom. nud.] — *Crypsinus nummularius* C. Presl, Epim. Bot. (1851) 123, nom. superfl. — *Craspedaria nummularia* Fée, Gen. Filic. (1850–1852) 264. — *Polypodium nummularium* Mett., Farngatt. I. Polyp. (1856) 105, nom. superfl. — *Goniophlebium nummularium* T. Moore, Index Filic. (1857) 74; II (1862) 262. — *Pleopeltis nummularia* Alderw., Bull. Dép. Agric. Ind. Néerl. 27 (1909) 4. — Type: *Meyen s.n.* (B). *Polypodium hammatisorum* Harrington, J. Linn. Soc. Bot. 16 (1877) 32; Alderw., Malayan Ferns (1908) 634. — *Pleopeltis hammatisorum* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — Type: *Steere s.n.* (K), Philippines, Luzon.

Rhizome 1 mm thick, internodes to 0.9–1.5 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands few. *Rhizome scales* peltate, spreading, 3–5 by 0.6–0.8 mm, acute, straw-coloured (rarely), or brown, evenly coloured, remotely and weakly dentate or short-dentate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 1–7 cm long; lamina 1.5–10 by 0.2–0.3 cm, index 1.4 to linear. Sterile fronds with stipe 0.2–4 cm long; lamina 1.4–4 by 1–1.7 cm, index 0.9–2.4, widest at 0.3–0.5 from base; base cuneate to cordate, apex round to acuminate. *Venation*: costa only distinct; veinlets free or anastomosing, free veinlets excurrent, rarely recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, flat to thickened; notches regularly present, absent or irregularly present in fertile fronds. *Sori* round, single between adjacent veins, in one row between costa and margin, 2–3 mm wide, slightly sunken.

Distribution — *Malesia*: Philippines.

Habitat — No data. Regarding the altitude only few data, one record from 900 m.

Note — *Selliguea whitfordii* differs in its less strongly dimorphic fronds, the fertile fronds wider, regularly with notches.

36. *Selliguea rigida* (Hook.) Hovenkamp

Selliguea rigida (Hook.) Hovenkamp, Blumea 43 (1998) 92. — *Drymoglossum rigidum* Hook., A Century of Ferns (1854) Tab. 96. — *Schizolepton rigidum* T. Moore, Index Filic. (1857) 30; II (1862) 344. — *Pycnoloma rigidum* C. Chr., Dansk Bot. Ark. 6 (1929) 76; Copel., Gen. Fil. (1947) 207. — Type: *Lobb s.n.* (K), Sarawak.

Drymoglossum tetragonum Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 21. — Type: *Teuscher s.n.* (BO, not found), Borneo.

Rhizome 1 mm thick, internodes to 0.5 cm long; vascular strands with bundle sheath fully sclerified; sclerenchyma strands many. *Rhizome scales* pseudopeltate or peltate, stiffly spreading, 6 by 0.6 mm, contracted to a narrow acumen with a dark pseudocosta, brown-blackish with a lighter hyaline margin, strongly dentate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 1.7–6.5 cm long; lamina 4–10 by 0.2 cm, linear. Sterile fronds with stipe 0.1–6.5 cm long; lamina 1–2.8 by 0.9–1.7 cm, index 1–2, widest at c. 0.5 from base. *Venation*: costa only distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin cartilaginous, strongly thickened; notches indistinct, sporadically present, absent in fertile fronds. *Sori* confluent across main veins, forming longitudinal coenosori, single between costa and margin, deeply sunken (not raised on upper surface).

Distribution — *Malesia*: Borneo.

Habitat — Epiphytic; both in kerangas and in lowland dipterocarp forest. Altitude from sea level to 380 m.

Note — A rare species. Easily recognised by the rigid stiffness of all its parts. It can only be confused with *Selliguea metacoela*, which is less stiff generally, has scales with a dull brown, entire acumen, and has coenosori which are not sunken.

37. *Selliguea setacea* (Copel.) Hovenkamp

Selliguea setacea (Copel.) Hovenkamp, Blumea 43 (1998) 72. — *Polypodium setaceum* Copel., Philipp. J. Sc., Bot. 5 (1911) 139. — *Holcosorus setaceus* Copel., Gen. Fil. (1947) 208. — Type: *Brooks 6* (BM), Sarawak.

Rhizome 2–3 mm thick, internodes not elongated. Vascular strands with hyaline sheath; sclerenchyma strands many. *Rhizome scales* pseudopeltate, spreading, 2.9–3 by 0.7–0.8 mm, contracted to a narrow acumen, brown, with a lighter margin and a central pseudocosta; base dentate; acumen entire or remotely and weakly dentate. *Fronds* simple, monomorphic. Stipe not distinct from lamina, 0.5–1.5 cm long; lamina 25–54 by 0.1–0.2 cm (in dry state), gramineous. *Venation*: costa only distinct; venation highly simplified. Hydathodes absent. Margin not differentiated; without notches. *Sori* round, two between adjacent veins, in one row between costa and margin, 1 mm wide, superficial.

Habitat — Epiphytic. The few available data indicate that this species may be mainly restricted to stunted summit or heath forests. Altitude 150–900 m.

Distribution — *Malesia*: Borneo.

Note — Often confused with a number of other gramineous forms and species; see under *S. ceratophylla*, *S. bisulcata*, *S. enervis* (gramineous forms), *S. subsparsa*, *S. lateritia*.

38. *Selliguea soridens* (Hook.) Hovenkamp

Selliguea soridens (Hook.) Hovenkamp, Blumea 43 (1998) 65. — *Polypodium soridens* Hook., Sp. Fil. 5 (1864) 61; Baker, Syn. Fil. (1868) 355; Alderw., Malayan Ferns (1908) 635. — *Pleopeltis soridens* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4; Malayan Ferns Suppl. (1917) 377. — *Crypsinus soridens* Copel., Gen. Fil. (1947) 206. — Type: *Wallace s.n.* (B, K), Sarawak.

Polypodium stenopteris Baker, J. Bot. (1879) 43; Alderw., Malayan Ferns (1908) 635. — *Pleopeltis stenopteris* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4; Malayan Ferns Suppl. (1917) 377. — *Selliguea stenopteris* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 152. — Type: *Burbidge* 297 (K), Borneo.

Pleopeltis smithii Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 29; Malayan Ferns Suppl. (1917) 379. — *Polypodium smithii* C. Chr., Index Filic. Suppl. pré. (1917) 28. — Type: *Rachmat* 603 (BO, not found), Celebes.

Rhizome 2–3 mm thick, internodes to 1–1.5 cm long; bundle sheath hyaline to fully sclerified; sclerenchyma strands many to very many. *Rhizome scales* peltate, spreading, 4.8–9 by 1–1.5 mm, acute or contracted to a narrow acumen, brown, evenly coloured, usually entire, rarely remotely and weakly dentate, sometimes also coarsely dentate at base. *Fronds* simple, dimorphic or internally dimorphic, fertile parts often forming a distinct apical spike. Fertile fronds with stipe 0.5–6 cm long (usually not very distinct). Lamina 5.5–49 by 0.1–0.4 cm (fertile part), index 9–98. Sterile fronds with stipe 1–2 cm long; lamina 3–8 by 0.7–1.9, index 2.5–9, widest at 0.5–0.7 from base. Fertile area 0.4–2.5 cm wide. *Venation*: costa only distinct, main veins indistinct, on upper surface not raised or raised; veinlets mostly anastomosing, free veinlets scarce. Hydathodes absent. Margin not differentiated or cartilaginous, thickened; notches regularly present. *Sori* round or longitudinally slightly elongate, in one row between adjacent veins, marginal, in one row between costa and margin, 3 mm across, deeply sunken, forming pustules to 1–1.5 mm high on upper surface. — **Fig. 29c.**

Distribution — *Malesia*: Borneo, Sulawesi, Moluccas.

Habitat — Epiphytic, epilithic or terrestrial. In mountain or mossy forest, often in moss cushions. Altitude 750–3150 m.

Notes — 1. *Selliguea soridens* can be confused with *S. stenophylla*. The following characters most easily distinguish the two species:

	<i>stenophyllus</i>	<i>soridens</i>
scales	bicolorous, dentate	concolorous, entire
margin	not notched	notched
fertile spike	narrowed	not narrowed
sori	well within margin	close to margin
mouth of soral cup	rimmed	wide

A few specimens from Borneo are more or less intermediate (*Chew et al.* 854, 1157), they have a monomorphic fronds and sori with a distinctly rimmed mouth, in these characters corresponding to *S. stenophylla*, but to *S. soridens* in other characters. From either species they differ in the rhizome without sclerenchyma strands.

2. Some specimens have a wide fertile area and sori located on protruding marginal teeth. A few specimens show some intergradation to *Selliguea stenophylla*.

39. *Selliguea sri-ratu* Hovenkamp

Selliguea sri-ratu Hovenkamp, Blumea 41 (1996) 19; 43 (1998) 70. — Type: *Iwatsuki c. s. B 2497* (L; iso BO), Borneo.

Rhizome 4–8 mm thick, phyllopods contiguous or internodes to 0.8 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands many. *Rhizome scales* pseudopeltate, spreading, 7–13 by 1.2–2.5 mm, acute, brown, evenly coloured (often with a weak pseudocosta), strongly dentate. *Fronds* simple, mono- to dimorphic. Fertile fronds with stipe 7–16 cm long; lamina 14–22 by 2.8–5.5 cm or longer, index 4.2–6.1, widest at 0.3–0.6 from base. Sterile fronds with stipe 7.5–18 cm long; lamina 16.5–22 by 3.4–5.9 cm, index 3.7–5.5, widest at 0.3–0.5 from base. *Venation*: main veins on upper surface raised, distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes absent, or infrequent, calcareous scales not persistent. Margin cartilaginous, flat or thickened; notches regularly present. *Sori* round, elongated or confluent across connecting veins to a transverse coenosorus, in one row, or occasionally in 2 irregular rows between adjacent main veins, in 2–4 rows between costa and margin, 2–3 mm wide, superficial. — **Fig. 30h.**

Distribution — *Malesia*: Borneo.

Habitat — Epiphytic; in forest. Altitude 660–960 m.

Note — Somewhat similar to *Selliguea heterocarpa*, but easily distinguished by the strongly dentate, pseudopeltate rhizome scales and the only occasionally confluent sori.

40. *Selliguea stenophylla* (Blume) Parris

Selliguea stenophylla (Blume) Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 151; Hovenkamp, Blumea 43 (1998) 67. — *Polypodium stenophyllum* Blume, Enum. Pl. Javae (1828) 124; Fl. Javae Filic. (1829) 134; Hook., Sp. Fil. 5 (1864) 65; Baker, Syn. Fil. (1868) 354; Alderw., Malayan Ferns (1908) 638; Backer & Posth., Varenfl. Java (1939) 196. — *Pleopeltis stenophylla* T. Moore, Index Filic. II (1862) 348; Bedd., Handb. Ferns Brit. India (1883) 348; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 5; Malayan Ferns Suppl. (1917) 379. — *Paragramma stenophylla* J. Sm., Hist. Fil. (1875) 115. — *Crypsinus stenophyllus* Holtum, Revis. Fl. Malaya 2 (1954) 199; Copel., Fern Fl. Philipp. (1960) 505; Kato & Price, Acta Phytotax. Geobot. 41 (1990) 71. — Type: *van Hasselt s. n.* (L), Java.

Polypodium batacorum Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 13 (1914) 220. — *Pleopeltis batacorum* Alderw., Malayan Ferns Suppl. (1917) 385. — Type: *J. Winkler 28a* (UC), Sumatra.

Polypodium cyathisorum Brause, Bot. Jahrb. Syst. 5 (1920) 198. — Type: *Schlechter 19650* (B, BM, K, P, UC), New Guinea.

Rhizome 1.5–3 mm thick, internodes to 1–1.5 cm long; vascular strands with bundle sheath hyaline; sclerenchyma strands few to many. *Rhizome scales* peltate, spreading, 5.5–8 by 0.9–1.5 mm, acute, whitish, straw-coloured, or brown, evenly coloured or (mostly) with a lighter margin, remotely and weakly dentate to short-dentate (sometimes irregularly). *Fronds* simple, monomorphic. Stipe 0.2–3.5 cm long (always in-

distinct, sometimes virtually absent). Lamina 1.5–26.5 by 0.7–1.6(–2) cm, index 1.4 to linear, widest at 0.2–0.7 from base; apex usually rounded or obtuse. *Venation*: costa only distinct, main veins indistinct, on upper surface rarely raised; veinlets anastomosing (free veinlets scarce). Hydathodes absent. Margin not differentiated; without notches or notches rarely sporadically present. *Sori* round, in one row between adjacent veins, in one row approximately medially between costa and margin, 2 mm wide, deeply sunken, with a slightly raised rim around the mouth, forming high narrow pustules on upper surface.

Distribution — Throughout *Malesia*.

Habitat — Epiphytic, rarely terrestrial. On trunks or branches, rarely on earth banks. Altitude 100–2550 m.

Note — The specimens from New Guinea have been distinguished as *Polypodium cyathisorum*. They are in some characters intermediate with *S. soridens*, with nearly or completely concolorous, entire rhizome scales, and a notched lamina margin. The narrow, submarginal sori with a raised rim are more typical for *S. stenophylla*.

41. *Selliguea stenosquamis* Hovenkamp

Selliguea stenosquamis Hovenkamp, Blumea 33 (1988) 396; 43 (1998) 80. — Type: Hennipman 5259 (L), Celebes.

Rhizome 1.5–2.5 mm thick, internodes to 1.7–3 cm long; vascular strands with bundle sheath absent to hyaline; sclerenchyma strands few to many. *Rhizome scales* peltate, squarrose, 3.5–6 by 0.3–0.6 mm, contracted to a narrow acumen, brown, evenly coloured; base irregularly dentate/lacerate; acumen entire. Fronds simple, mono- to dimorphic. Fertile fronds with stipe 2–16 cm long; lamina 8–18(–31) by 1.3–4(–9.5) cm, index 5–6.4, widest at 0.3 from base. Sterile fronds with stipe 1.5–10.5 cm long; lamina 2–14 by 1.4–4.5 cm, index 2.7–3.5, widest at 0.3 from base. *Venation*: main veins distinct, raised on upper surface; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin not differentiated or cartilaginous, thickened; notches regularly present. *Sori* round, in 2 rows between adjacent veins, in 5 or more rows between costa and margin, 1 mm wide, superficial.

Distribution — *Malesia*: Sulawesi.

Habitat — Epiphytic or epilithic; in mountain forest. Altitude 1000–2250 m.

Note — Distinct from *Selliguea enervis* mainly in the constantly subulate and strongly recurved rhizome scales.

42. *Selliguea subsparsa* (Baker) Hovenkamp

Selliguea subsparsa (Baker) Hovenkamp, Blumea 43 (1998) 80. — *Polypodium subsparsum* Baker, J. Bot. (London) 18 (1880) 215; Alderw., Malayan Ferns (1908) 630; C. Chr., Gard. Bull. Str. Settle. 7 (1934) 307. — *Pleopeltis subsparsa* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 3. — *Crypsinus subsparsus* Copel., Gen. Fil. (1947) 207. — Type: Beccari s.n. (K), Sumatra.

Polypodium wrayi Baker, J. Bot. 2 (1887) 206; Ann. Bot. (London) 5 (1891) 90; Alderw., Malayan Ferns (1908) 633. — *Pleopeltis wrayi* Bedd., Suppl. Ferns Brit. India (1892) 93; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4. — *Crypsinus wrayi* Holttum, Revis. Fl. Malaya 2 (1954) 200. — Type: Wray 573 (K), Malaya.

Polypodium beccarii Alderw., Malayan Ferns (1908) 633; Bull. Dép. Agric. Indes Néerl. 18 (1908) 22; C. Chr., Gard. Bull. Str. Settle. 7 (1934) 307. — *Pleopeltis beccarii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 4; Bull. Jard. Bot. Buitenzorg II, 28 (1918) 37. — Type: *Beccaria* 449 (BO, not found), Sumatra.

Pleopeltis insperata Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 28; Malayan Ferns Suppl. (1917) 380. — *Polypodium insperatum* C. Chr., Index Filic. Suppl. pré. (1917) 26. — Type: *Matthew* 692 (BM, BO, K), Sumatra.

Rhizome 1–2 mm thick, internodes to 0.5–1 cm long. Vascular strands with bundle sheath hyaline; sclerenchyma strands few to many. *Rhizome scales* peltate, appressed (occasionally), or spreading, 2–4 by 0.5–1 mm wide, acute or rarely contracted to a narrow acumen, straw-coloured (rarely), or brown, evenly coloured or with a lighter margin, strongly dentate, rarely short-dentate. *Fronds* simple, mono- to dimorphic. Fertile fronds with stipe 1.5–11 cm long; lamina 5–28 by 0.2–1.2 cm, widest at 0.3–0.6 from base or linear. Sterile fronds with stipe 0.5–7 cm long; lamina 5.5–19 by 0.4–1.3 cm, index 1.5–20 or more, widest at 0.3–0.6 from base. *Venation*: costa only distinct; veinlets anastomosing, free veinlets excurrent and recurrent. Hydathodes absent. Margin not differentiated or cartilaginous, flat or thickened; notches regularly present, sporadically to regularly present in fertile fronds. *Sori* round, in two rows between adjacent veins, in 1–5 rows between costa and margin, 1.5–3 mm wide, superficial.

Distribution — *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Sulawesi.

Habitat — Epiphytic or epilithic. Often as a high epiphyte in forest, or in mountain or summit forest. Altitude 1200–2500 m.

Note — Variably dimorphic. In Sumatra fairly large forms occur which vary from distinctly to hardly dimorphic, with one to several rows of sori between costa and margin. In Peninsular Malaysia, specimens are more consistently small, dimorphic. A monomorphic form with uniformly narrow, mostly fertile fronds is easily confused with *Selliguea setacea*, and with narrow forms of *S. enervis* and *S. ceratophylla*.

43. *Selliguea subtaeniata* (Alderw.) Hovenkamp

Selliguea subtaeniata (Alderw.) Hovenkamp, Blumea 43 (1998) 52. — *Pleopeltis subtaeniata* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 30; Malayan Ferns Suppl. (1917) 402. — *Polypodium subtaeniatum* C. Chr., Index Filic. Suppl. pré. (1917) 28; Gard. Bull. Str. Settle. 7 (1934) 309. — Type: *Forbes* 2061 (BM, BO), Sumatra.

Pleopeltis matthewi Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 30; Malayan Ferns Suppl. (1917) 401. — *Polypodium matthewi* C. Chr., Index Filic. Suppl. pré. (1917) 27, nom. illeg., non Tutch. (1905). — Type: *Matthew* 503 (BM, BO, K), Sumatra.

Pleopeltis pseudo-laciniata Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 38. — *Polypodium pseudo-laciniata* C. Chr., Index Filic. Suppl. 3 (1934) 156. — Types: *Bünnemeijer* 889, 1275 (L), Sumatra.

Rhizome 6–8 mm thick, internodes to 0.5–1 cm long; vascular strands with bundle sheath absent; sclerenchyma strands very many. *Rhizome scales* pseudopeltate, spreading to squarrose, 5–10 by 2–2.5 mm, acute or contracted to a narrow acumen, brown to blackish (often mottled), evenly coloured or with a lighter margin (sometimes very narrow), strongly dentate, or sometimes with an entire acumen. *Fronds* pinnatifid to pinnate, monomorphic. Stipe 20–48 cm long; lamina 18–36 cm long, pinnae 1–5 pairs, width of connecting strip up to 0.2 cm (mostly absent); largest

pinna is 1–4, blade 13–22 by 1–1.6 cm wide, widest at 4–9 cm, with a cusp 1–4 cm long. Basal pinnae unequally broadly adnate, lamina cut to costa on basiscopic side. *Venation*: main veins distinct, on upper surface raised, connecting veins also distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened; notches regularly present. *Sori* round, single between adjacent veins, in one row between costa and margin, at 2–3 mm from costa, 2–4 mm wide, superficial.

Distribution — *Malesia*: Sumatra.

Habitat — Epiphytic or terrestrial; in forest. Altitude 900–2400 m.

Note — In the deeply dissected lamina this resembles *S. taeniata*, but in the characters of the rhizome and rhizome scales it resembles *S. laciniata*. With *S. laciniata* it also shares the shape of the basis of the pinnae, which is unequal and narrowed at the basiscopic side, often to the midrib. The pinna-base in *S. taeniata*, if unequal, is nearly always narrowed at the acroscopic side.

44. *Selliguea taeniata* (Sw.) Parris

Selliguea taeniata (Sw.) Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 152; Hovenkamp, Blumea 43 (1998) 48. — *Polypodium taeniatum* Sw., J. Bot. (Schrader) 1800 (2) (1801) 26; Syn. Fil. (1806) 38, 232; C. Chr., Arkiv f. Bot. 9 (1910) 32; Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 161; Backer & Posth., Varenfl. Java (1939) 221. — *Pleopeltis taeniata* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 30; Malayan Ferns Suppl. (1917) 401. — *Phymatodes taeniata* Ching, Bull. Fan Mem. Inst. Biol. 10 (1941) 239. — *Crypsinus taeniatum* Copel., Gen. Fil. (1947) 206; Holttum, Revis. Fl. Malaya 2 (1954) 195; Tagawa, Acta Phytotax. Geobot. 15 (1954) 143; Copel., Fern Fl. Philipp. (1960) 502; De Vol & Kuo, Fl. Taiwan 1 (1975) 175; Kato & Price, Acta Phytotax. Geobot. 41 (1990) 70. — *Phymatopsis taeniata* Ching, Acta Phytotax. Sin. 9 (1964) 193. — *Phymatopteris taeniata* Pichi Serm., Webbia 28 (1973) 465, Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 107 — Type: *Thunberg s.n.* (BM, fragm.), Java.

Polypodium angustatum Blume, Enum. Pl. Javae (1828) 133, nom illeg., non Swartz (1806); Fl. Javae Filic. (1829) 148. — *Pleuridium angustatum* J. Sm., Ferns Brit. & For. (1866) 96. — *Polypodium palmatum* var. *angustatum* Alderw., Malayan Ferns (1908) 670. — *Pleopeltis palmata* var. *angustata* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Polypodium taeniatum* var. *angustatum* C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 161. — Type: *van Hasselt s.n.* (L), Java.

Polypodium palmatum Blume, Enum. Pl. Javae (1828) 131; Fl. Javae Filic. (1829) 150; Hook., Sp. Fil. 5 (1864) 88; Baker, Syn. Fil. (1868) 368; Alderw., Malayan Ferns (1908) 66. — *Drynaria palmata* J. Sm., J. Bot. (Hook.) 3 (1841) 397. — *Microsorium palmatum* Fée, Gen. Filic. (1850–1852) 269. — *Pleopeltis palmata* T. Moore, Index Filic. II (1862) 347; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 11. — *Pleuridium palmatum* J. Sm., Ferns Brit. & For. (1866) 96. — *Phymatopsis palmatum* J. Sm., Hist. Fil. (1875) 105. — *Polypodium taeniatum* var. *palmatum* C. Chr., Gard. Bull. Str. Settle. 7 (1934) 310. — *Crypsinus taeniatum* var. *palmatus* C. Chr., Index Filic. Suppl. 1 (1913) 126; Holttum, Revis. Fl. Malaya 2 (1954) 197. — *Phymatopteris palmata* Pichi Serm., Webbia 28 (1973) 464. — *Phymatopteris taeniata* var. *palmata* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 108. — *Selliguea taeniata* var. *palmata* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 152. — Type: *Reinwardt s.n.* (L), Moluccas, Tidore.

Polypodium moseleyi Baker, J. Linn. Soc. Bot. 15 (1876) 110; Alderw., Malayan Ferns (1908) 669. — *Pleopeltis moseleyi* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10; Malayan Ferns Suppl. (1917) 401. — *Crypsinus moseleyi* Copel., Gen. Fil. (1947) 206. — Type: *Moseley s.n.* (K), Moluccas, Ternate.

- Polypodium quinquefidum* Baker, J. Bot. n.s. 9 (1880) 216; Alderw., Malayan Ferns (1908) 660. — *Pleopeltis quinquefida* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 9; Malayan Ferns Suppl. (1917) 395. — Type: *Beccari s.n.* (K), Sumatra
- Polypodium griffithianum* var. *borneense* H. Christ, Ann. Jard. Bot. Buitenzorg II, 5 (1905) 122; Alderw., Malayan Ferns (1908) 646. — *Pleopeltis griffithiana* var. *borneensis* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6. — *Polypodium taeniatum* var. *borneense* C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1928) 161; Gard. Bull. Str. Settle. 7 (1934) 310. — *Crypsinus taeniatum* var. *borneense* Tagawa, Acta Phytotax. Geobot. 22 (1967) 189. — *Selliguea taeniata* var. *borneensis* Parris, Sandakania 9 (1997) 108. — Syntypes: *Hallier 684, 3286* (BO), Borneo.
- Pleopeltis taenifrons* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 31; Malayan Ferns Suppl. (1917) 402. — *Polypodium taenifrons* C. Chr., Index Filic. Suppl. pré. (1917) 28. — Type: *Rachmat 896* (BO), Celebes.
- [*Pleopeltis crenulata* C. Presl, Tent. Pterid. (1836) 197, nom. nud. — *Polypodium crenulatum* Mett., Farngett. I. Polypodium (1856) 110, nom. nud.] — *Pleopeltis crenulata* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 59. — *Polypodium crenulatum* C. Chr., Gard. Bull. Str. Settle. 7 (1934) 310, nom. illeg., non Gmelin (1791). — Type: *Rachmat 485* (BO), Celebes.
- Pleopeltis taenitidis* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 31; Malayan Ferns Suppl. (1917) 402. — *Polypodium taenitidis* C. Chr., Index Filic. Suppl. pré. (1917) 28. — Type: *Matthew 658* (BO, K, L), Sumatra, Indrapoera.
- Polypodium lepidosorum* C. Chr., Leaf. Philipp. Bot. 9 (1933) 3166. — Type: *Elmer 22208* (B, BM, BO, K, P, SING, UC), Philippines, Luzon.
- Polypodium pakkaense* C. Chr., Gard. Bull. Str. Settle. 7 (1934) 310. — *Phymatopteris pakkaensis* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 107. — *Selliguea pakkaensis* Parris in Parris, Beaman & Beaman, The plants of Mount Kinabalu. I. Ferns and fern allies (1991) 152. — Type: *Holttum 25515* (BM, BO, UC), Borneo.
- Polypodium mjobergii* C. Chr., Dansk Bot. Ark. 9 (1937) 70. — Type: *Mjöberg 6* (BM), Borneo.
- Crypsinus ramosii* Copel., Fern Fl. Philipp. (1960) 506; Zamora & Co, Guide Philipp. Flora & Fauna II (1986). — Type: *Ramos BS 14825* (MICH, UC), Philippines, Camiguin de Mindanao.

Rhizome 5–9 mm thick, internodes to 0.5–3 cm long; vascular strands with bundle sheath incompletely to fully sclerified; sclerenchyma strands many to very many. *Rhizome scales* pseudopeltate, spreading, 9–12 by 2.5–4.5 mm wide, acute, evenly coloured, dull brown, often with an indistinct pseudocosta, entire or short-dentate, often with irregular, coarse protrusions. *Fronds* pinnate, dimorphic. Fertile fronds: stipe 24–36 cm long; lamina 22–40(–110) cm long, pinnae 5–12(–35) pairs, the lowest pinnae of well-developed fronds often free, others adnate; largest fertile pinna is 1–4, blade 12–20 by 0.8–3.5 cm, widest at 4–7 cm, with a cusp 1.5–4 cm long. Sterile fronds: stipe 19–39 cm long; lamina 20–41 cm long, pinnae 3–12 pairs, basal pinnae often fertile near apex; largest sterile pinna, blade 12–17 by 1.5–3.1(–4.5) cm, widest at 4–6.5 cm, with a cusp 1.5–3.5 cm long, with 4–6 rows of closed areoles. Rachis and costae on upper surface grooved. *Venation*: connecting veins distinct to veinlets distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, flat or thickened; notches regularly present. *Sori* round, occasionally slightly elongate towards margin, single between adjacent veins, in one row between costa and margin, at 2–7 mm from costa, 2–3 mm wide, superficial.

Distribution — Throughout *Malesia*, common, but rare in New Guinea.

Habitat — Epiphytic, epilithic or terrestrial. Low on trunks in forest, in streambeds, on roadsides etc. Sometimes in deep shade. Altitude from sea level to 3400 m.

Notes — 1. Several more or less distinct forms can be distinguished, but the distinctions between these forms are gradual.

'*Polypodium palmatum*' — Smaller plants, with markedly dimorphic fronds. Pinnae generally fewer, not or slightly narrowed at base, often connected by a 1–2 mm wide band. Sori often closer to the costa than to the margin. Margin inconstantly notched, particularly in specimens from the Philippines. This form is restricted to the eastern part of the distribution range (Peninsular Malaysia, Borneo, Philippines, Moluccas), and is the predominant form in the Philippines.

'*Polypodium quinquefidum*' — As '*palmatum*', but rhizome scales shining, and pinnae long, narrow, with a long cusp. Few specimens only, in mossy forest in Borneo and Sulawesi.

'*Polypodium pakkaense*' — As '*palmatum*', but fronds pinnatifid, all pinnae connected along the rachis, not or hardly dimorphic, texture more coriaceous, venation more prominent, margin very distinctly notched, almost toothed, the rhizome usually with fewer sclerenchyma strands. Restricted to Mt Kinabalu, at the upper end of the altitudinal range (1500–3400 m) for *Selliguea taeniata*.

'*Polypodium stenurum*' — A slender form, with very long fronds (to over 1 m incl. stipe) with a large number of narrow pinnae (to 35 or more), a thin texture, and an indistinctly cartilaginous, but very distinctly notched margin.

An unnamed form has rhizome scales which are more strongly contracted to a narrow acumen, and pinnae with a strongly narrowed, often abruptly cuneate base, and a short stipe. It is represented by few specimens from Borneo (*Mjöberg 1*, 8; *Native collector 112*, *Clemens 28153*).

Juvenile plants sometimes have simple fronds, which nevertheless may be fertile (*Loher 882*, *Parris 5719*, *Matthew s.n.*, March 1907, all K). Such plants have been separated as var. *borneense*. Intermediates have the pinnae connected along the costa.

2. Possibly simple-fronded plants like these have been identified as *Phymatopteris hastata* (Thunb.) Pichi Serm. by Zamora & Co [Guide Philipp. Flora & Fauna II (1986) 29]. Other than through this reference, *P. hastata* is not known from the Philippines.

45. *Selliguea tafana* (C. Chr.) Hovenkamp

Selliguea tafana (C. Chr.) Hovenkamp, *Blumea* 43 (1998) 36. — *Polypodium tafanum* C. Chr., *Brittonia* 2 (1937) 311. — Type: *Brass 5028* (BM, NY), New Guinea.

Polypodium squamisorum C. Chr., *Bull. Misc. Inform.* 1 (1939) 29. — Type: *MacGregor 15* (BM), New Guinea.

Rhizome 3–4 mm thick, internodes to 1–2.5 cm long; vascular strands with bundle sheath fully sclerified, to 2 cells thick; sclerenchyma strands many to very many. *Rhizome scales* peltate, spreading to squarrose, 4–6.5 by 1–1.5, acute, brown to blackish, evenly coloured, with a lighter margin, or with irregular dark spots, short-dentate. *Fronds* simple, strongly dimorphic. Fertile fronds with stipe 0.5–4 cm long; lamina 4–10(–19) by 0.5–1.2 cm, index 7.5–12.5, widest at 2–5.5 from base, or linear. Sterile fronds with stipe 1–7.5 cm long; lamina 6–17.5 by 1.3–3 cm, index 3.3–7.3, widest at 0.3–0.5 from base. Costa only distinct or main veins distinct also. *Venation*: main veins on upper surface not raised or raised. Hydathodes absent. Margin not

differentiated to cartilaginous, thickened; without notches. *Sori* round to elongate, single between adjacent veins, in one row between costa and margin, 4–5 mm wide (receptacle usually covering most of the areole), superficial.

Distribution — *Malesia*: scattered throughout the mountain ranges of Papua New Guinea.

Habitat — Epiphytic or epilithic. In montane to subalpine forest, often pendent from branches, in shrubbery, or in alpine grasslands. Altitude 2400–3600 m.

Notes — 1. Most easily recognised (if the characteristic persistent soral scales are absent) by the narrowly ovate-elliptic sterile fronds, and the fertile fronds being nearly always not only narrower but also shorter than the sterile ones. *Selliguea tafana* is not always clearly distinct from *S. lauterbachii*, with which it co-occurs in the lower end of its altitudinal range.

2. The most common form of this species was described as *Polypodium squamisorum*. This form is compact, and several specimens of this form have many persistent scales on the lamina and especially in the sori, giving them a highly characteristic appearance. This is only one extreme of a variable character: other specimens have few or very few persistent scales.

3. *Selliguea tafana* was described on the basis of a larger, laxer form, with few persistent scales. A few specimens have some radially organised shoots, a feature that is more common in *S. ferrea*.

46. *Selliguea triloba* (Houtt.) M.G. Price

Selliguea triloba (Houtt.) M.G. Price, Contr. Univ. Mich. Herb. 17 (1990) 276; Hovenkamp, Blumea 43 (1998) 57. — *Polypodium trilobum* Houtt., Nat. Hist. (1783) 148; Backer & Posth., Varenfl. Java (1939) 221. — *Phymatodes triloba* Ching, Bull. Fan Mem. Inst. Biol. 1 (1941) 239. — *Crypsinus trilobus* Copel., Gen. Fil. (1947) 206; Holttum Revis. Fl. Malaya 2 (1954) 196; Copel., Fern Fl. Philipp. (1960) 503. — *Phymatopsis triloba* Ching, Acta Phytotax. Sin. 9 (1964) 194. — *Phymatopteris triloba* Pichi Serm., Webbia 2 (1973) 465. — Type: *Thunberg s.n.* (not traced), Java.

Polypodium triphyllum Jacq., Coll. (1788) 126. — *Phymatodes triphylla* C. Chr. & Tardieu, Notul. Syst. 8 (1939) 284; Tardieu & C. Chr. in Fl. Indo-Chine 7, 2 (1941) 470. — Type: Jacquin, pl. 22 f. 1.

Polypodium incurvatum Blume, Enum. Pl. Javae (1828) 126; Fl. Javae Filic. (1829) 151; Hook., Sp. Fil. (1864) 77; Baker, Syn. Fil. (1868) 363; Alderw., Malayan Ferns (1908) 663. — *Pleopeltis incurvata* T. Moore, Gard. Chron. (1860) 1105; Bedd., Handb. Ferns Brit. India (1883) 364; Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10; Malayan Ferns Suppl. (1917) 399; Malayan Ferns Suppl. 1, Corrections (1917) 58. — *Phymatopsis incurvatum* J. Sm., Hist. Fil. (1875) 105. — Type: *Blume s.n.* (L, P).

Selliguea matutumensis Copel., Philipp. J. Sc. 81 (1952) 44; Fern Fl. Philipp. (1960) 509; Zamora & Co, Guide Philipp. Flora & Fauna II (1986) 159. — Type: *Copeland s.n.* (UC), Philippines.

Rhizome 4–6.5 mm thick, internodes to 1.5–4 cm long; vascular strands 11–14, with bundle sheath partially sclerified; sclerenchyma strands very many. *Rhizome scales* peltate, appressed or spreading, 3.8–4 by 1.2–1.8 mm, obtuse to acute (often apiculate), whitish to brown, with a lighter margin, entire to short-dentate, also irregularly lacerate. *Fronds* simple to pinnate, strongly dimorphic. Fertile fronds: stipe 14–50 cm long, lamina simple, pinnatifid or fully pinnate, rarely bipinnatifid, 13–27 cm long. Simple fronds 1–1.3 cm wide, widest at 3–12 cm from base. Pinnatifid/

pinnate fronds with 3–7 pairs of pinnae, width of connecting strip 0.1 cm (or less); largest fertile pinna is 1, blade 11–18 by 0.7–1.3 cm, with a cusp 0–2 cm long. Sterile fronds: stipe 7–40 cm long; lamina simple, trilobed or pinnatifid, 6–33 cm long. Simple fronds (or end lobes of trilobed fronds) 4.1–8.8 cm wide, widest at 2 cm from base. Pinnae 1–4(–7) pairs, width of connecting strip 0.4–2 cm; largest sterile pinna: blade 4.5–15(–21) by 2.3–5.5 cm, widest at 0.2–0.5 from base, acute or cuspidate with a cusp to 2 cm long. *Venation*: main veins on upper surface not raised, distinct, veinlets rarely also distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes absent or present. Margin cartilaginous, thickened; notches sporadically or regularly present, in fertile fronds sometimes absent. *Sori* round, single between adjacent veins, in one row between costa and margin, at 1.5–3 mm from costa, 4 mm wide, deeply sunken. — **Fig. 30d.**

Distribution — Indochina, Hainan. *Malesia*: Sumatra, Peninsular Malaysia, Java, Borneo, Philippines, Moluccas.

Habitat — Epiphytic, epilithic or terrestrial. In forest, also in more exposed situations. Altitude 540–3200 m.

Notes — 1. In specimens from Java and Sumatra hydathodes are absent, and fertile fronds are less distinctly notched than sterile fronds. In specimens from Peninsular Malaysia, Borneo and the Philippines, hydathodes may be present in both sterile and fertile fronds, occasionally they are present in fertile fronds only. Specimens from these latter areas have also more regularly notched fertile fronds.

2. Depauperate forms have simple fertile and sterile fronds (Borneo: *Nooteboom & Chai 1803*, Philippines: *Copeland s.n.*, type of *Selliguea matutumensis*). These can be distinguished from *S. heterocarpa* by the distinctive rhizome scales.

47. *Selliguea triquetra* (Blume) Ching

Selliguea triquetra (Blume) Ching, Bull. Fan Mem. Inst. Biol. 10 (1941) 238; Hovenkamp, Blumea 43 (1998) 84. — *Polypodium triquetrum* Blume, Enum. Pl. Javae (1828) 124; Fl. Javae Filic. (1829) 141; Sp. Fil. 5 (1864) 63; Baker, Syn. Fil. (1868) 359; Alderw., Malayan Ferns (1908) 650; Backer & Posth., Varenfl. Java (1939) 201. — *Pleuridium triquetrum* J. Sm., Ferns Brit. & For. (1866) 95; Hist. Fil. (1875) 95. — *Pleopeltis triquetra* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 7; Malayan Ferns Suppl. (1917) 387. — *Crypsinus triquetrus* Copel., Gen. Fil. (1947) 207. — *Crypsinopsis triquetra* Pichi Serm., Webbia 31 (1977) 242. — Type: *Blume s.n.* (L), Java.

Polypodium vulcanicum Blume, Enum. Pl. Javae (1828) 122, Fl. Javae Filic. (1829) 144. — *Pleuridium vulcanicum* J. Sm., Hist. Fil. (1875) 95. — Type: *Reinwardt s.n.* (L), Moluccas, Ternate. *Polypodium rhomboideum* Blume, Enum. Pl. Javae (1828) 124. — Type: *Blume s.n.* (not found).

Rhizome 3–7 mm thick (or more), internodes to 1–2.5 cm long; vascular strands with bundle sheath partially sclerified; sclerenchyma strands many to very many. Ground tissue very soft. *Rhizome scales* peltate, appressed to spreading, 5–9 by 2–3 mm, obtuse to mostly rounded, somewhat concave, sometimes acute, straw-coloured, with a lighter flabelloid margin, entire. *Fronds* simple, dimorphic. Fertile fronds with stipe 11–23 cm long; lamina 12–30 by 2.3–6.4 cm, index 3.9–6.7, widest at 0.2–0.4 from base. Sterile fronds with stipe 4.5–12 cm long; lamina 11–28 by 4.1–8.5 cm, index 2.2–3.3, widest at 0.3–0.4 from base. *Venation*: main veins distinct, on upper surface not raised or raised. Hydathodes frequent, calcareous scales not persistent.

Margin cartilaginous, flat or thickened; notches absent, rarely regularly present, in fertile fronds absent. *Sori* round, rarely confluent within one areole, in two rows between adjacent veins, in 5 or more rows between costa and margin, 2–3 mm wide, superficial, but clearly marked on upper surface.

Distribution — *Malesia*: Sumatra, Java, Lesser Sunda Islands, Sulawesi, Moluccas? (doubtfully).

Habitat — Epiphytic, epilithic or terrestrial; in forest, scrub or open places, often in summit vegetation. Altitude 1200–3300 m.

Note — Specimens collected without the rhizome cannot be distinguished from *S. enervis* with certainty. *Selliguea triquetra* differs from *S. enervis* in the distinctly elongated rhizome, with internodes up to 2.5 cm in well-developed specimens, and with wide, obtuse to rounded scales. If the scales fall off, they usually do so completely in *S. triquetra*, whereas in *S. enervis* usually the base remains tightly fixed to the rhizome, and only the acumen disappears. The sori in *S. triquetra* are usually slightly larger than in *S. enervis*, and more often tend to become elongated or confluent. Sterile specimens, on the other hand, are very difficult to distinguish from *S. feei* or related species. The best distinction here is that *S. feei* usually lacks sclerenchyma strands in the rhizome. However, this cannot distinguish *S. triquetra* from, e.g., *S. caudiformis* or some forms of *S. bellisquamata*.

48. *Selliguea violascens* (Mett.) Hovenkamp

Selliguea violascens (Mett.) Hovenkamp, Blumea 43 (1998) 53. — *Polypodium violascens* Mett. in Miq., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 227; Baker, Syn. Fil. (1868) 365; Alderw., Malayan Ferns (1908) 665; Backer & Posth., Varenfl. Java (1939) 220. — *Pleopeltis violascens* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 10; Malayan Ferns Suppl. (1917) 400. — Type: *Wichura s.n.* (B), Java.

Rhizome 4–8 mm thick, internodes to 1–2.5 cm long; vascular strands with bundle sheath fully sclerified, 1–2 cells thick; sclerenchyma strands few, inconspicuous. *Rhizome scales* pseudopeltate or peltate, spreading, 6.5–11 by 2–2.2 mm, acute or contracted to a narrow acumen, shiny brown, evenly coloured, short-dentate to strongly dentate, more strongly dentate towards apex. *Fronds* pinnate, internally dimorphic. Fertile fronds: stipe 13.5–21 cm long; lamina 23–32 cm long (or longer). Pinnae 10–11 pairs, close, inserted more or less transversely to the rachis, sometimes overlapping; largest fertile pinna is 2–4, blade 13–15 by 1.1–1.5 cm, narrowed at base, widest at 6–8 cm, with a cusp to 1 cm long. Narrow scales often persistent on costa and veins. *Venation*: rachis and costae on upper surface grooved, main veins on upper surface distinct, not raised or raised, connecting veins also distinct; veinlets free and anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened; notches regularly present. *Sori* round, single between adjacent veins, in one row between costa and margin, at 2.5 mm from costa, 3 mm wide, superficial to deeply sunken.

Distribution — *Malesia*: Java, Sumatra.

Habitat — Epiphytic in forests. Altitude 1300–2700 m.

Notes — 1. A neglected but not particularly rare species, easily recognisable by the rhizome which has few sclerenchyma except around the vascular strands and conspicuously shiny, dentate scales.

2. The sori may be sunken (sometimes very deeply, forming high papillae on the upper surface) or completely superficial.

49. *Selliguea whitfordii* (Copel.) Hovenkamp

Selliguea whitfordii (Copel.) Hovenkamp, *Blumea* 43 (1998) 60. — *Polypodium whitfordii* Copel., Philipp. J. Sc. 1, Suppl. (1906) 256; Alderw., *Malayan Ferns* (1908) 646. — *Pleopeltis whitfordii* Alderw., Bull. Dép. Agric. Indes Néerl. 27 (1909) 6; *Malayan Ferns* Suppl. (1917) 384. — *Crypsinus whitfordii* Copel., Gen. Fil. (1947) 206; Fern Fl. Philipp. (1960) 504; Zamora & Co, *Guide Philipp. Flora & Fauna* II (1986) 149. — Type: *Copeland* 2032 (B, P), Philippines, Luzon.

Crypsinus subdimorphus Copel., Fern Fl. Philipp. (1960) 505. — Type: *Copeland* s.n. (UC), Philippines.

Rhizome 1–1.5 mm thick to 1–3 cm long; vascular strands with bundle sheath partially or fully sclerified; sclerenchyma strands few. **Rhizome scales** peltate, spreading, 4–5 by 0.5–0.9 mm, acute, brown, evenly coloured, remotely and weakly dentate to short-dentate, or irregularly strongly dentate. **Fronds** simple, dimorphic. Fertile fronds: stipe 1.5–6.5(–9) cm long; lamina 2.2–10(–13) by 0.6–1.6 cm, index 2.4–11, widest at 0.2–0.4 from base. Sterile fronds: stipe 1.3–5.5(–7.5) cm long; lamina 1.5–5(–9.5) by 0.8–2.8 cm, index 1.3–3.3, widest at 0.2–0.6 from base. **Venation**: main veins on upper surface raised, distinct; veinlets free (rarely), or anastomosing, free veinlets excurrent and recurrent. Hydathodes frequent, calcareous scales not persistent. Margin cartilaginous, thickened; notches regularly present. **Sori** round, single between adjacent veins (rarely a few areoles with 2 sori), in one row between costa and margin (rarely a few in a second row), 2.5–4 mm wide, slightly sunken.

Distribution — *Malesia*: Philippines.

Habitat — Epiphytic or epilithic. Altitude 1000–1600 m.

Note — *Selliguea pyrolifolia* is more strongly dimorphic, with a more obscure venation, fertile fronds with a sinuose margin, often without notches.

THYLACOPTERIS

(G. Rödl-Linder)

Thylacopteris Kunze ex J. Sm., Hist. Fil. (1875) 87; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 304; Copel., Gen. Fil. (1947) 181; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 228, Rödl-Linder, *Blumea* 39 (1994) 351. — *Polypodium* subg. *Ctenopteris* Blume, J. Sm., J. Bot. (Hook.) 3 (1841) 394. — Type species: *Polypodium papillosum* Blume (= *Thylacopteris papillosa*).

Medium-sized ferns. **Rhizome** terete, long-creeping with internodes 0.5–6(–12) cm long, 2–6 mm thick, covered with scales. Anatomy: ground tissue parenchymatous, vascular strands 4–14, with or without bundle sheaths, sclerenchyma strands absent or present. **Rhizome scales** deciduous, appressed to spreading, pseudopeltate, clathrate, dull brown, to 6.5 mm long, apex acute to acuminate, margin entire, cell walls in the basal part sinuose, apically straight, warty. **Fronds** monomorphic, stipitate, pectinate; lamina equally wide throughout or somewhat wider near the base; 3.6–11.2 × as long as wide, herbaceous, midrib raised above, pinnae with an indistinct abscission

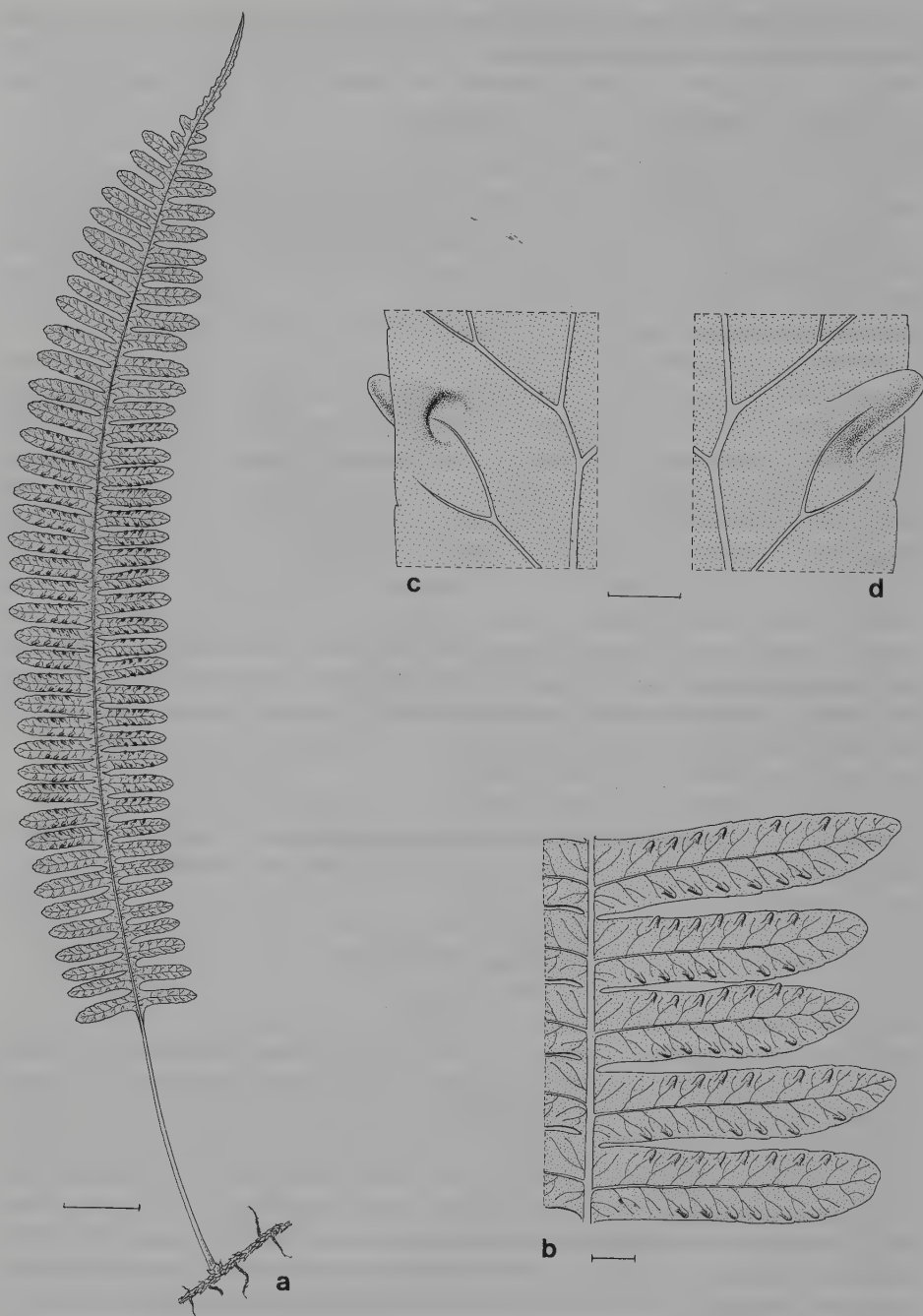


Fig. 31. *Thylacopteris papillosa* (Blume) J. Sm. a. Habit; b. fertile pinnae; c. sorus from below; d. sorus from above (Kato *et al.* C 7471). Scale bars: a = 2 cm, b = 3.5 mm, c, d = 1 mm. Drawing by J.H. van Os.

layer at their base, perpendicular to the rachis, the lowermost rarely slightly reduced or reflexed, gradually reduced towards the apex, pinna margin entire, crenate or serrate, apex obtuse to acute, texture membranaceous, glabrous or with inconspicuous, 2-celled glandular hairs. *Venation* free, veins simple or once forked, terminating in hydathodes. *Sori* in a single row between costa and margin, medial, terminal on the acroscopic veins, round, 0.5–1.8 mm, receptacular paraphyses absent. Sporangia stalked, capsule c. 0.3 mm long, with 10–12 indurated annulus cells. Spore light yellow, smooth or pustulate and shallowly wrinkled, with few or many globules. — **Fig. 31.**

Distribution — Throughout *Malesia*.

Taxonomy — *Thylacopteris* is unique among the *Polypodiaceae* with clathrate scales in having an abscission line between the pinnae and the midrib, although this line is hardly ever seen to be functional. In most other characters the genus is rather similar to *Goniophlebium*, to which it is probably closely allied. The two species of *Thylacopteris* have sometimes been considered as conspecific, but their differences are clear and consistent.

KEY TO THE SPECIES

- 1a. *Sori* superficial, stipes to 13 cm long, rhizome without sclerenchyma strands, vascular strands without bundle sheaths **1. *T. diaphana***
- b. *Sori* deeply sunken, stipes to 22 cm long, rhizome with sclerenchyma strands, vascular strands with bundle sheaths **2. *T. papillosa***

1. *Thylacopteris diaphana* Copel.

Thylacopteris diaphana Copel., Gen. Fil. (1947) 182; Rödl-Linder, Blumea 39 (1994) 361. — *Polypodium diaphanum* Brause, Bot. Jahrb. Syst. 49 (1912) 42, nom. illeg., non Bory (1804). — Type: *Schlechter* 18220 (B; iso L), New Guinea.

Rhizome 2–3 mm thick, internodes 3–12 cm long, vascular strands without sclerenchymatous sheaths, sclerenchyma strands absent. *Rhizome scales* 2.3–4.4 mm. Stipe to 13 cm, lamina to 45 by 6.5 cm, 4–5 × as long as the stipe, pinnae 5–7 mm wide, crenate to serrate, obtuse to acute. Veins free, simple or once forked, very rarely uniting to form an empty areole. *Sori* superficial, 1–1.8 mm diam. Sporangia on stalks c. 0.4 mm long. Spores 58–64 µm, slightly pustulate with a reticulate perispore.

Distribution — *Malesia*: New Guinea.

Habitat — In forest, epiphytic or epilithic, on cliffs or near brooks. Altitude 750–1400 m.

2. *Thylacopteris papillosa* (Blume) J. Sm.

Thylacopteris papillosa (Blume) J. Sm., Hist. Fil. (1875) 87; Copel., Fern Fl. Philipp. (1960) 463; Rödl-Linder, Blumea 39 (1994) 361. — *Polypodium papillosum* Blume, Enum. Pl. Javae (1828) 131; Benn. et al., Pl. Jav. Rar. (1838) 6, pl. 2; Hook., Cent. Ferns, pl. 46; Sp. Fil. 4 (1862) 198; Holttum, Revis. Fl. Malaya 2 (1954) 202. — Type: *Zippelius* 89 (L), Java.

Rhizome 1–6 mm thick, internodes 0.5–6 cm long, vascular strands with light to dark brown sclerenchymatous sheaths, sclerenchyma strands 12 to many. *Rhizome*

scales 2.4–3.9 mm. Stipe to 22 cm long; lamina to 59 by 8(–10) cm, 1.5–4 × as long as the stipe, pinnae to 7 mm wide, increasingly crenate towards the apex or sometimes crenate throughout, obtuse or acute to rounded. Veins free, simple or once forked. *Sori* deeply sunken, forming narrow, to 2 mm high papillae on the adaxial surface, 0.5–1 mm diam. Sporangia on stalks 0.8–1.7 mm long, protruding when mature. Spores 54–64 μm , smooth. — **Fig. 31.**

Distribution — Throughout *Malesia*, except for New Guinea.

Habitat — In forest, epiphytic, on trunks, or epilithic, on boulders, nearly always in shady locations. Altitude (0–)500–1500(–3500) m.

DAVALLIACEAE

(H.P. Nooteboom, Leiden, The Netherlands)

Davalliaceae Mett. ex Frank in Leunis, Syn. Pflanzenk., ed. 2, 3 (1877) 1474; K.U. Kramer in K. Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 74–80.

Epiphytic, epilithic, or rarely terrestrial. *Rhizome* dorsiventral, scaly with extra-axillary buds near the leaves, creeping, usually long (short in *Gymnogrammitis*, not in Malesia) and densely covered with scales (and often also hairs in *Leucostegia*). *Leaves* alternately in two ranks on the dorsal side of the rhizome and articulated at the base to phyllopodia. Extra-axillary buds alternately in two ranks on the ventral-lateral sides of the rhizome; each bud intermediate between two succeeding phyllopodia in *Leucostegia* and in *Gymnogrammitis*, lateral to the phyllopodium or lower lateral and slightly anterior in the other genera. Roots on the ventral side of lateral buds, in *Leucostegia* scattered on all sides of the rhizome, in *Gymnogrammitis* along the entire ventral side of it. The vascular structure of the rhizome a dorsiventral dictyostele. Stele with a thick dorsal and a thick ventral vascular strand, in *Gymnogrammitis* only a thick dorsal strand. In *Leucostegia* the dorsiventral dictyostele with elongate leaf gaps with two simple leaf traces, in all other taxa many leaf traces for a leaf arising from the dorsal and ventral strands and from a strand connecting the two, the traces finely anastomosing in each leaf gap, the connecting strands thin and obscure. In *Leucostegia* scales basifixed with broad bases attached to the rhizome, often with hairs on the rhizome or on the base of the scales. In the other genera the rhizome scales peltate or basally attached with a cordate, overlapping, base (sometimes called pseudopeltate). The scales acicular, flat and nearly acicular, evenly narrowed towards the apex above the much broader base, or just evenly narrowed. In a number of species apical and marginal multicellular hairs on the scales. Scales often ciliate or toothed, the ciliae or teeth consisting of two upturned ends of adjacent marginal cells.

Incision of the *leaves* very diverse, from an entire leaf to a decomposed leaf with uni-veined ultimate segments, in *Davallia repens* even in an individual plant. Pinnules anadromous, the apical pinnule of at least the lower pinnae inserted nearer to the rachis than the basal pinnule, or catadromous, the other way round, in *Davallodes* and sometimes in *Davallia membranulosa*. Axes adaxially grooved, the grooves with raised centre; edges of laminar parts continuous with the ridges (wings) bordering the axis groove; costae and costules adaxially convex. Lamina often firm in texture, usually triangular, sometimes narrowed towards the base; when mature mostly without macroscopical epidermal appendages (hairy in *Davallodes* and some species of *Davallia*). Veins pinnately branched, free, ending behind the margin or reaching it. 'False veins' occasionally present between the true veins.

Sori strictly terminal in *Leucostegia*, various in the other genera (facing midveins either at the bending point or at the forking point of veins); indusium attached at the base, often also at the sides or part of them, rarely reniform with a short point of attachment, or absent (in *Gymnogrammitis*); soral trichomes present or not. Receptacle not elevated.

DISTRIBUTION

North to south from Korea to New South Wales and Three Kings Island N of New Zealand, and west to east from west tropical Africa, the Canary Islands and SW Europe to the Marquesas in the Pacific.

Literature: Ching, R.C., Davalliaceae, in Fl. Reip. Popul. Sin. 2 (1959) 280–319, 374–378. — Kato, M., A systematic study of the genera of the Fern family Davalliaceae. J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 13 (1985) 553–573; Taxonomic studies of Pteridophytes of Ambon and Seram (Mollucas) collected by Indonesian-Japanese botanical expeditions II. Davalliaceae and Oleandraceae. J. Fac. Sci. Univ. Tokyo, sect. 3, 14 (1989) 226. — Nootboom, H.P., Notes on Davalliaceae I. The genera Araiostegia, Davallodes, Leucostegia, and Gymnogrammitis. Blumea 37 (1992) 165–187; Notes on Davalliaceae II. A revision of the genus Davallia. Blumea 39 (1994) 151–214.

CHROMOSOMES

In *Leucostegia* $x = 41$, the chromosome counts indicate that *L. immersa* in India and Taiwan is diploid (Tryon & Lugardon 1991: 374); in *Gymnogrammitis* $x = 36$, the count from a plant in Yunnan, Dali also indicates diploidy (M. Kato et al. 1992: 108); in the other genera $x = 40$, triploidy is reported in *Davallia repens* from Sri Lanka (Manton & Sledge 1954).

References: Kato, M., et al., Cytotaxonomic study of ferns of Yunnan, Southwestern China. Bot. Mag. (Tokyo) 105 (1992) 105–124. — Manton, I. & W. A. Sledge, Observations on the cytology and taxonomy of the pteridophyte flora of Ceylon. Philos. Trans. Roy. Soc. London, B 238 (1954) 127–185. — Tryon, A. F. & B. Lugardon, Spores of the Pteridophyta (1991).

KEY TO THE GENERA

- 1a. Pinnules of at least the larger pinnae catadromous. Rhizome scales acicular or nearly acicular **Davallodes** (p. 268)
- b. Pinnules of at least the larger pinnae anadromous. Rhizome scales acicular or not 2
- 2a. Scales basifixed along broad base, roots borne on all sides of rhizome, sori terminal at the vein endings **Leucostegia** (p. 274)
- b. Scales peltate or pseudopeltate, roots restricted to the ventral side of lateral buds, sori facing midveins at the forking point at the bending of veins, extra-axillary buds lateral to the phyllopodia, or lower lateral and slightly anterior . **Davallia** (p. 236)

DAVALLIA

- Davallia* Sm., Mém. Acad. Sci. Turin 5 (1793) 414; Copel., Fern Fl. Philipp. (1958) 170; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 354; Noot., Blumea 39 (1994) 155. — Type species: *Davallia canariensis* (L.) Sm.
- Wibelia* Bernh. (non Fée 1852), J. Bot. (Schrader) 1800 (1801) 122, t. 1, f. 2. — *Davallia* sect. *Wibelia* M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 13 (1985) 566. — Type species: *Wibelia elata* Bernh.
- Humata* Cav., Descr. Pl. (1802) 272; Copel., Fern Fl. Philipp. (1958) 175; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 364. — Type species: *Humata ophioglossa* Cav.
- Pachypleuria* C. Presl, Tent. Pterid. (1836) 128; Epim. Bot. (1851) 98; M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 13 (1985) 567. — Type species: *Pachypleuria pedata* (Sm.) C. Presl.

- Stenolobus* C. Presl, Tent. Pterid. (1836) 129, t. 4, f. 30. — Type species: *Davallia solida* (G. Forst.) Sw.
- Parestia* C. Presl, Epim. Bot. (1851) 99. — Type species: *Parestia elegans* C. Presl.
- Pteroneuron* Fée, Mém. Foug. 5. Gen. Filic. (1852) 320, t. 25B, f. 1. — Type species: *Pteroneuron parallelum* Fée.
- Scyphularia* Fée, Mém. Foug. 5. Gen. Filic. (1852) 324, t. 26B, f. 1. — Type species: *Scyphularia pentaphylla* (Blume) Fée.
- Parasorus* Alderw., Bull. Jard. Bot. Buitenzorg III, 4 (1922) 317, t. 14. — Type species: *Parasorus undulatus* Alderw. [= *Davallia undulata* (Alderw.) Noot.].
- Araiostegia* Copel., Philipp. J. Sc. 34 (1927) 240, t. 1, 2; Fern Fl. Philipp. (1958) 166; Holtum, Revis. Fl. Malaya, ed. 2, 2 (1966) 364. — Type species: *Araiostegia hymenophylloides* (Blume) Copel.
- Trogostolon* Copel., Philipp. J. Sc. 34 (1927) 251, t. 4; Fern Fl. Philipp. (1958) 170. — Type species: *Trogostolon falcinellus* (C. Presl) Copel.
- Paradavallodes* Ching, Acta Phytotax. Sin. 11 (1966) 18. — Type species: *Paradavallodes multidentata* (Hook.) Ching.
- Davallia* sect. *Cordisquama* M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 13 (1985) 566. — Type species: *Davallia divaricata* Blume.

Roots restricted to the ventral side of lateral buds. Scales of *rhizome* peltate or basifixed with cordate base and overlapping lobes, variously shaped: distinctly acicular, flat and nearly acicular, narrowed evenly towards the apex, narrowed abruptly from a broad base, or broad, ovate to oblong-subdeltoid with round to acute apex. *Lamina* deltoid and broadest towards the base or rarely elongate, glabrous or rarely bearing multicellular hairs. Vein endings on sterile segments reaching the margin or not. False veins present or not. Rachis winged and therefore seemingly grooved adaxially (in dry state it is difficult to see whether the rachis itself is grooved or flat). Indusia and sori separate but in *D. undulata* indusia and sori connate and elongate along leaf margins. *Sori* facing midveins at the forking point of veins or at the bending point of a vein. — **Fig. 1.**

Distribution — From India through continental SE Asia to China, Korea, and Japan; throughout *Malesia*; NE Australia; in the Pacific to Samoa and New Zealand; the islands in the Indian Ocean; Africa (1 species in NW Africa); Canary Islands; SW Europe.

Legends to Plates 1–4: SEM photographs of indusia; scale bar = 1 mm.

→ →

Plate 1: 1. *Davallia angustata* (van Balgooy 5378). – 2. *D. brassii* (Brass 9097). – 3. *D. brevipes* (Hennipman 5580). – 4. *D. corniculata* (Iwatsuki T-8383). – 5. *D. denticulata* var. *denticulata* (Clemens 21459). – 6. *D. denticulata* var. *elata* (Kato C-4182). – 7. *Idem* (Nootboom 5351). – 8. *D. divaricata* var. *divaricata* (Nootboom 1221).

Plate 2: 9. *Davallia embolostegia* (Nootboom 2246) – 10. *D. falcinella* (Elmer 14013). – 11. *D. heterophylla* (van Niel 3429). – 12. *D. parvula* (Anderson 10012). – 13. *D. pectinata* (Braithwaite 4571). – 14–16. *D. repens* (Brass 27402, LAE 58472, Main & Aden 510, respectively).

Plate 3: 17–21. *Davallia repens* (Price & Hernaez 713, Brass 7166, S 28663, Nootboom 5542, Brooke 9064, respectively). – 22. *D. rouffaeriensis* (Docters van Leeuwen 10248). – 23. *D. sessilifolia* (de Vogel 7166). – 24. *D. sessilifolioides* (Kato C-5336).

Plate 4: 25. *Davallia solida* var. *solida* (Hennipman 6147). – 26. *D. trichomanoides* var. *trichomanoides* (Schmutz 18). – 27. *D. wagneriana* (Kjellberg 3658). – 28. *D. pentaphylla* (Kato C-1655) – 29. *D. seramensis* (Kato C-1276). – 30. *D. triphylla* (de Wilde c.s. 20708). – 31. *D. undulata* (Pleyte 363).

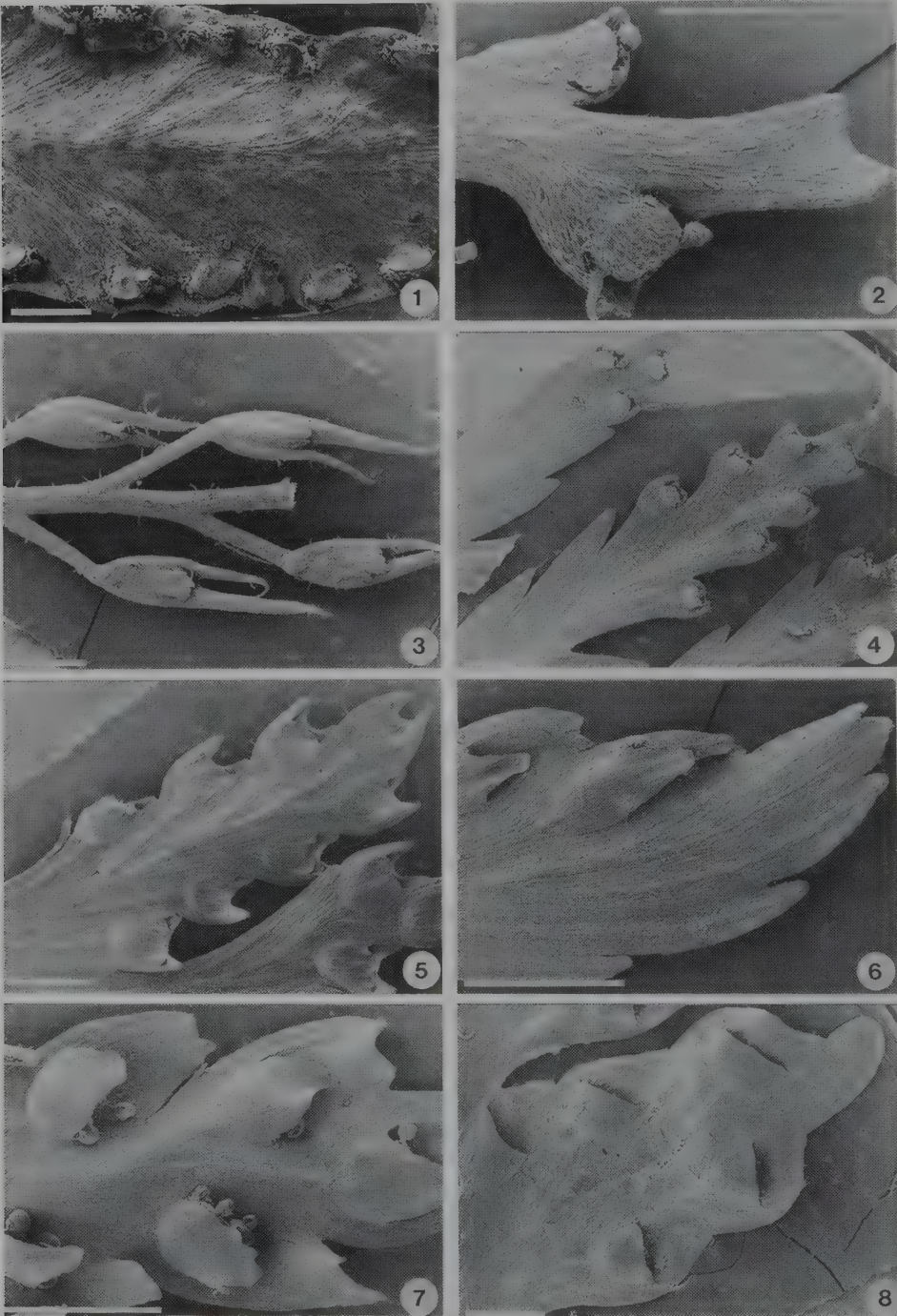


Plate 1 — Legend on page 237.

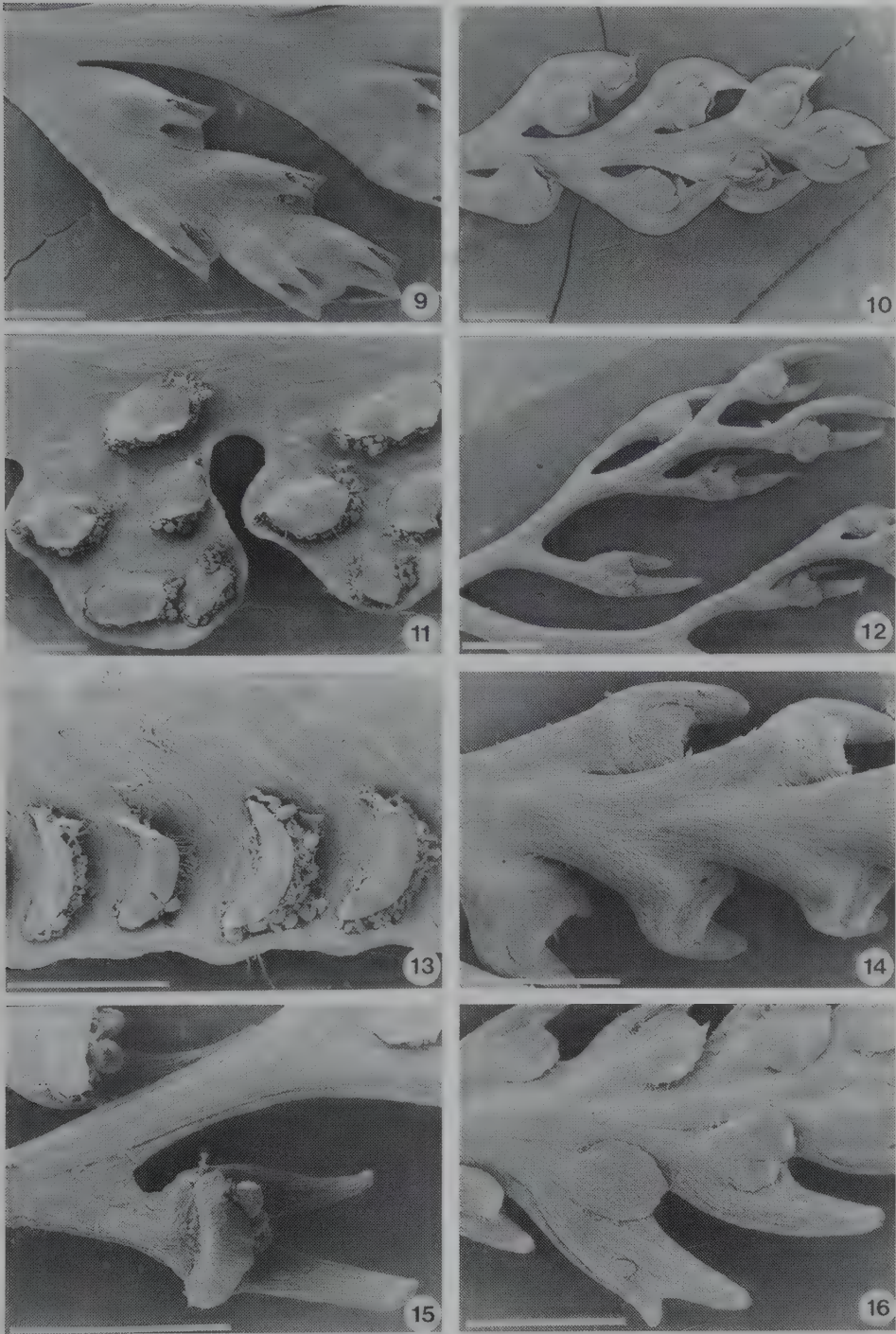


Plate 2 — Legend on page 237.

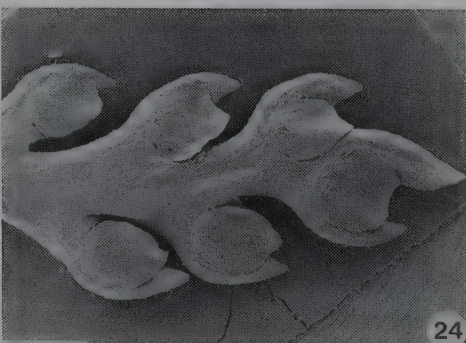
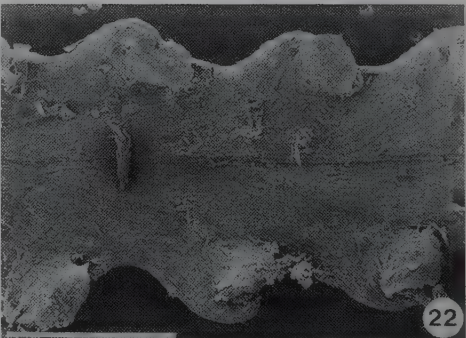
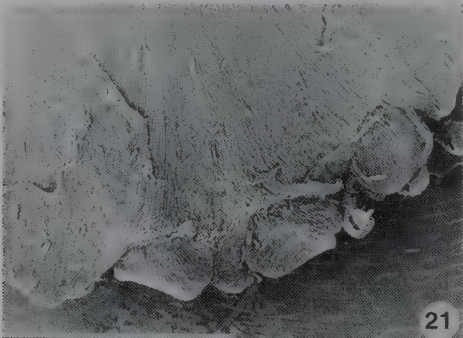
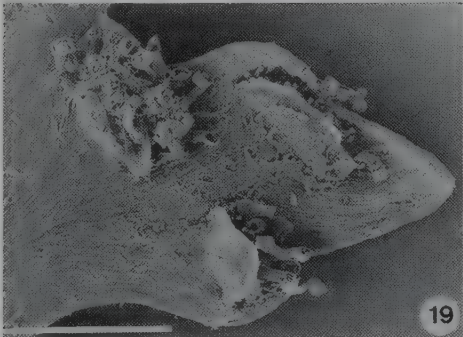
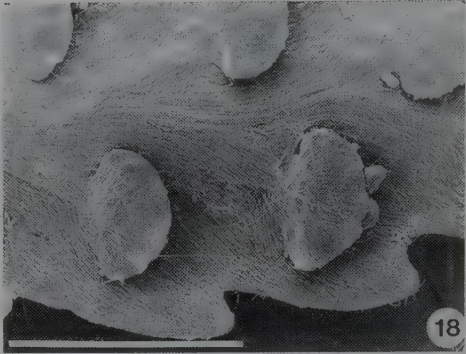
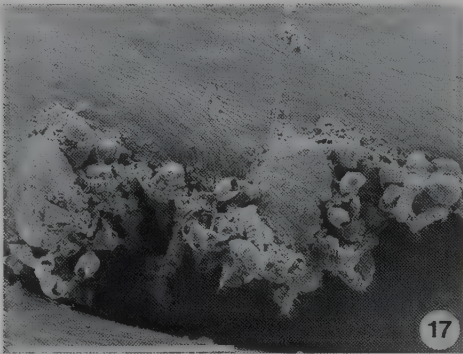


Plate 3 — Legend on page 237.



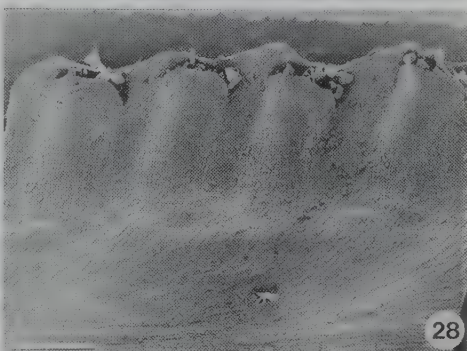
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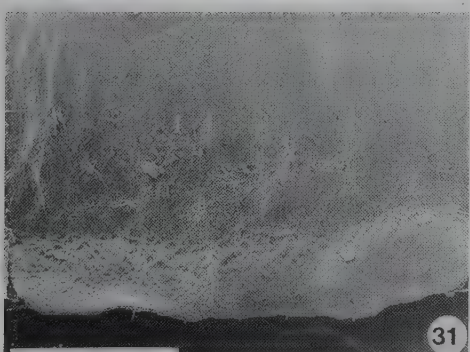
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KEY 1 TO THE SPECIES

(use Key 2 if it is clear whether the rhizome scales are peltate or pseudopeltate)

- 1a. Lamina imparipinnate and leaflets entire or nearly so, occasionally lobed at the base or once branched, or lamina simple, entire to pinnatilobed, pectinate or pinnatifid, or 3-foliate, the leaflets more or less divided 2
 - b. Lamina compound or pinnate towards its base 10
- 2a. Lamina simple, pectinate or pinnatifid, or 3-foliate, the leaflets more or less divided 3
 - b. Lamina imparipinnate, leaflets entire or nearly so, occasionally lobed at the base or once branched, or lamina simple, entire to pinnatilobed 5
- 3a. Lamina pectinate, narrowly ovate **12. *D. pectinata***
 - b. Lamina of simple or pinnate leaf ovate 4
- 4a. Rhizome scales often curling backward **15. *D. sessilifolia***
 - b. Rhizome scales not or seldom curling backward **13. *D. repens***
- 5a. Sori connate, elongate along leaf margins **23. *D. undulata***
 - b. Sori separate 6
- 6a. Indusium attached at the broad base and hardly or not at the sides, rhizome scales narrowed evenly towards the apex, or flat and nearly acicular, narrowed abruptly from a broad base, indusium semicircular 7
 - b. Indusium also attached along the sides, pouch-shaped, rhizome scales distinctly acicular, indusium oblong 8
- 7a. Lamina strongly dimorphous, rhizome scales with a pale border quickly diminishing or disappearing towards the apex, indusium wider than long, 1.5–2.5 mm broad **9. *D. heterophylla***
 - b. Leaf not or slightly dimorphous, rhizome scales without pale border, indusium about as wide as long, 0.6–0.8 mm broad **1. *D. angustata***
- 8a. Rhizome scales not bearing multiseptate hairs, rhizome white waxy under the rhizome scales, margin of leaflets in simple or imparipinnate sterile leaves not distinctly crenulate even towards the apex, indusium about as wide as long, 1 mm long **21. *D. seramensis***
 - b. Rhizome scales bearing multiseptate hairs at least when young, rhizome not white waxy, margin of leaflets in simple or imparipinnate sterile leaves distinctly crenulate to dentate at least towards the apex, indusium longer than wide, 1.5–2.5 mm long 9
- 9a. Rhizome scales not or seldom curling backward, appressed to rhizome, 5 mm long, margin of sterile leaves recurved or revolute **22. *D. triphylla***
 - b. Rhizome scales often curling backward, 6–10 mm long, margin of sterile leaves flat or nearly so **20. *D. pentaphylla***
- 10a. Rhizome white waxy under the rhizome scales 11
 - b. Rhizome not white waxy 21
- 11a. Sori borne several on a segment 12
 - b. Sori frequently single on a segment 15
- 12a. Rhizome scales not or seldom curling backward or appressed to rhizome 13
 - b. Rhizome scales often curling backward 14

- 13a. Indusium also attached along the sides, pouch-shaped, oblong **19. *D. wagneriana***
- b. Indusium attached at the broad base and hardly or not at the sides, semicircular, or more or less triangular to rhomboid **13. *D. repens***
- 14a. Lamina pinnate towards the base, false veins not present, indusium semicircular, 1.1–1.8 mm long, 1.2–1.8 mm broad **15. *D. sessilifolia***
- b. Lamina compound, false veins present, indusium more or less triangular to rhomboid, or oblong, 0.5 mm long and broad **4. *D. corniculata***
- 15a. Lamina entirely divided into fine linear segments without obvious rachis **11. *D. parvula***
- b. Lamina pinnate with pinnatilobed to pinnatifid pinnae, bipinnate, tripinnate or quadri-pinnate 16
- 16a. Lamina pinnate towards the base 17
- b. Lamina compound 19
- 17a. Lamina narrowly ovate, elongate, often narrowing towards the base **14. *D. rouffaeriensis***
- b. Lamina ovate, deltoid, broadest towards the base 18
- 18a. Rhizome scales lacking marginal setae or teeth, or those rare, or toothed, vein endings on sterile segments not reaching the margin **16. *D. sessilifolioides***
- b. Rhizome scales with marginal setae at least in distal part, vein endings on sterile segments reaching the margin **13. *D. repens***
- 19a. Lamina bearing multicellular hairs, ultimate segments or lobes acute and usually ending in a tooth, leaf axes hairy, indusium also attached along the sides, pouch-shaped, oblong, longer than wide, upper margin elongated, free, extending to lamina margin or not **3. *D. brevipes***
- b. Lamina glabrous, ultimate segments or lobes obtuse or acute without a tooth, leaf axes glabrous, indusium attached at the base and only part of the sides or attached at the broad base and hardly or not at the sides, semicircular or more or less triangular to rhomboid, wider than long or about as wide as long, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not . 20
- 20a. Rhizome scales not or seldom curling backward **13. *D. repens***
- b. Rhizome scales castaneous, often curling backward **2. *D. brassii***
- 21a. Sori borne several on a segment 22
- b. Sori frequently single on a segment 26
- 22a. False veins present 23
- b. False veins not present 24
- 23a. Indusium upper margin elongated, free **5b. *D. denticulata* var. *elata***
- b. Indusium upper margin not elongated, truncate or slightly rounded **5a. *D. denticulata* var. *denticulata***
- 24a. Rhizome scales bearing multiseptate hairs (when young), with pale border from base to apex, peltate, lamina generally extending into a tooth only at the outside of a sorus or not extending into teeth beyond a sorus . . **17. *D. solida* var. *solida***
- b. Rhizome scales not bearing multiseptate hairs, without pale border, basifixed with cordate base and greatly overlapping lobes, lamina generally extending into a tooth at both sides of a sorus 25

- 25a. Indusium upper margin elongated, free, indusium longer than wide **7. *D. embolostegia***
 b. Indusium upper margin not elongated, truncate or slightly rounded, indusium about as wide as long **6a. *D. divaricata* var. *divaricata***
- 26a. Indusium also attached along the sides, pouch-shaped, pinnae deltoid or ovate 27
 b. Indusium scaly, attached at the narrow, cordate base only, attached at the base and only part of the sides, or attached at the broad base and hardly or not at the sides, pinnae linear-triangular 29
- 27a. Lamina strongly dimorphous, rhizome scales narrowed evenly towards the apex, scales basifixed with cordate base and greatly overlapping lobes, 30–40 cm long, ultimate leaflets lobed halfway towards the midrib or only shallowly lobed, veins in sterile ultimate lobes pinnate, vein endings on sterile segments reaching the margin, indusium semicircular, wider than long, 1.5–2.5 mm broad **6b. *D. divaricata* var. *dimorpha***
 b. Leaf not or slightly dimorphous, rhizome scales distinctly acicular or flat and nearly acicular, narrowed abruptly from a broad base or above the much broader base evenly narrowed towards the apex, scales peltate, stipes 4.5–20 cm long, ultimate leaflets lobed almost to the midrib, veins in sterile ultimate lobes frequently simple or forked, vein endings on sterile segments not reaching the margin, indusium oblong, longer than wide, 0.5–1 mm broad 28
- 28a. Rhizome scales nearly black **18b. *D. trichomanoides* var. *lorrainii***
 b. Rhizome scales brown or red-brown **18a. *D. trichomanoides* var. *trichomanoides***
- 29a. Indusium scaly, attached at the narrow, cordate base only, reniform, wider than long, rhizome scales basifixed with cordate base and greatly overlapping lobes, sori at the bending point of a vein **10. *D. hymenophylloides***
 b. Indusium attached at the base and only part of the sides or attached at the broad base and hardly or not at the sides, semicircular or \pm triangular to rhomboid, about as wide as long, rhizome scales peltate, sori at the forking point of veins ... 30
- 30a. Lamina pinnate towards the base with pinnatilobed to pinnatifid pinnae, elongate, often narrowing towards the base, rhizome scales brown, narrowed evenly towards the apex, indusium more or less triangular to rhomboid, 0.4–0.6 mm long and broad **14. *D. rouffaeriensis***
 b. Lamina compound, distinctly acicular, tripinnate or quadripinnate, deltoid and broadest towards the base, rhizome scales nearly black, indusium semicircular, 1 mm long and broad **8. *D. falcinella***

KEY 2 TO THE SPECIES

- 1a. Rhizome scales basifixed with cordate base and greatly overlapping lobes .. 2
 b. Rhizome scales peltate 5
- 2a. Sori frequently single on a segment, indusium reniform or semicircular, wider than long 3
 b. Sori borne several on a segment, indusium oblong, longer than wide, or about as wide as long 4

- 3a. Leaves not or slightly dimorphous, elongate, often narrowing towards the base, pinnae linear-triangular, veins in sterile ultimate lobes frequently simple, the vein endings on sterile segments not reaching the margin, sori at the bending point of a vein, indusium scaly, attached at the narrow, cordate base only, reniform, 0.4–0.7 mm broad **10. D. hymenophylloides**
- b. Leaves strongly dimorphous, lamina deltoid and broadest towards the base, pinnae deltoid, veins in sterile ultimate lobes pinnate, the vein endings on sterile segments reaching the margin, sori at the forking point of veins, indusium also attached along the sides, pouch-shaped, semicircular, 1.5–2.5 mm broad **6b. D. divaricata** var. **dimorpha**
- 4a. Indusium upper margin elongated, free, indusium longer than wide **7. D. embolostegia**
- b. Indusium lips or upper margin not elongated, truncate or slightly rounded, indusium about as wide as long **6a. D. divaricata** var. **divaricata**
- 5a. Lamina imparipinnate, leaflets entire or nearly so, occasionally lobed at the base or once branched, or one entire to pinnatilobed simple leaf **6**
- b. Lamina compound, simple, pectinate, pinnatifid, or pinnate towards the base, or 3-foliate, the leaflets more or less divided **11**
- 6a. Sori and indusia connate, elongate along leaf margins **23. D. undulata**
- b. Sori and indusia separate **7**
- 7a. Rhizome not white waxy, rhizome scales bearing multiseptate hairs at least when young, indusium longer than wide, 1.5–2.5 mm long **8**
- b. Rhizome white waxy, scales not bearing multiseptate hairs, indusium wider than long or about as wide as long, 0.5–1 mm long **9**
- 8a. Rhizome scales not or seldom curling backward, appressed to rhizome, 5 mm long, margin of sterile leaves recurved or revolute **22. D. triphylla**
- b. Rhizome scales often curling backward, 6–10 mm long, margin of sterile leaves flat or nearly so **20. D. pentaphylla**
- 9a. Leaves strongly dimorphous, indusium wider than long, 1.5–2.5 mm broad **9. D. heterophylla**
- b. Leaves not or slightly dimorphous, indusium about as wide as long, 0.6–1 mm broad **10**
- 10a. Rhizome scales distinctly acicular, with pale border quickly diminishing or disappearing towards the apex, often curling backward, 3–5 mm long, margins of fertile leaves not distinctly crenulate even towards the apex, indusium attached at the base and also along the sides, pouch-shaped, oblong **21. D. seramensis**
- b. Rhizome scales narrowed evenly towards the apex, without pale border, not or seldom curling backward, 6–8 mm long, margins of fertile leaves distinctly crenulate to dentate at least towards the apex, indusium attached at the broad base and hardly or not at the sides, semicircular **1. D. angustata**
- 11a. Lamina simple, one pectinate or pinnatifid leaf, or 3-foliate, the leaflets more or less divided **12**
- b. Lamina compound or pinnate towards the base **14**
- 12a. Rhizome scales often curling backward, lamina pectinate ... **15. D. sessilifolia**
- b. Rhizome scales not or seldom curling backward, lamina pectinate or not ... **13**

- 13a. Lamina ovate-deltoid and broadest towards the base **13. *D. repens***
 b. Lamina narrowly ovate, elongate, often narrowing towards the base
 **12. *D. pectinata***
- 14a. Lamina pinnate towards the base 15
 b. Lamina compound 20
- 15a. Sori frequently single on a segment 16
 b. Sori borne several on a segment 18
- 16a. Lamina narrowly ovate, elongate, often narrowing towards the base
 **14. *D. rouffaeriensis***
 b. Lamina ovate-deltoid and broadest towards the base 17
- 17a. Vein endings on sterile segments not reaching the margin, rhizome scales lacking marginal setae or teeth, or those rare, or toothed **16. *D. sessilifolioides***
 b. Vein endings on sterile segments reaching the margin, rhizome scales with marginal setae at least in distal part **13. *D. repens***
- 18a. Indusium attached at base and also along the sides, pouch-shaped, oblong
 **19. *D. wagneriana***
 b. Indusium attached at the base and only part of the sides or attached at the broad base and hardly or not at the sides, semicircular or more or less triangular to rhomboid 19
- 19a. Rhizome scales often curling backward, toothed **15. *D. sessilifolia***
 b. Rhizome scales not or seldom curling backward, with marginal setae at least in distal part **13. *D. repens***
- 20a. Sori borne several on a segment 21
 b. Sori frequently single on a segment 26
- 21a. Rhizome not white waxy 22
 b. Rhizome white waxy under the scales 24
- 22a. Rhizome scales not or seldom curling backward, bearing multiseptate hairs at least when young, false veins not present **17. *D. solida* var. *solida***
 b. Rhizome scales often curling backward, not bearing multiseptate hairs, false veins present 23
- 23a. Indusium upper margin elongated, free **5b. *D. denticulata* var. *elata***
 b. Indusium lips or upper margin not elongated, truncate or slightly rounded
 **5a. *D. denticulata* var. *denticulata***
- 24a. Rhizome scales often curling backward, margins of the lamina of each leaflet thickened **4. *D. corniculata***
 b. Rhizome scales not or seldom curling backward, margins of the lamina of each leaflet not thickened 25
- 25a. Indusium also attached along the sides, pouch-shaped, oblong
 **19. *D. wagneriana***
 b. Indusium attached at the broad base and hardly or not at the sides, semicircular, or more or less triangular to rhomboid **13. *D. repens***
- 26a. Lamina bearing multicellular hairs, leaf axes hairy, ultimate segments of leaves ending in an acute tooth **3. *D. brevipes***
 b. Lamina glabrous, leaf axes glabrous, ultimate segments of leaves not ending in an acute tooth 27

- 27a. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide 28
- b. Indusium attached at the base and only part of the sides, or attached at the broad base and hardly or not at the sides, semicircular or more or less triangular to rhomboid, wider than long, or about as wide as long 29
- 28a. Rhizome scales nearly black **18b. *D. trichomanoides* var. *lorrainii***
- b. Rhizome scales brown or red-brown **18a. *D. trichomanoides* var. *trichomanoides***
- 29a. Rhizome not white waxy, scales nearly black, distinctly acicular, vein endings on sterile segments not reaching the margin **8. *D. falcinella***
- b. Rhizome white waxy under the scales, scales brown or red-brown, narrowed evenly towards the apex, vein endings on sterile segments reaching the margin . 30
- 30a. Rhizome scales often curling backward **2. *D. brassii***
- b. Rhizome scales not or seldom curling backward 31
- 31a. Lamina pinnate with pinnatilobed to pinnatifid pinnae or bipinnate, tripinnate, or quadripinnate **13. *D. repens***
- b. Lamina entirely divided into fine linear segments without obvious rachis **11. *D. parvula***

Section Davallia

Davallia sect. *Davallia*: M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 13 (1985) 566. — *Wibelia* Bernh. — *Davallia* sect. *Wibelia* M. Kato — *Humata* Cav. — *Pachypleuria* C. Presl — *Stenolobus* C. Presl — *Parestia* C. Presl — *Pteroneuron* Fée — *Araiostegia* Copel. — *Trogostolon* Copel. — *Paradavallodes* Ching — *Davallia* sect. *Cordisquama* M. Kato.

For a more detailed synonymy, see under the genus.

Scales not acicular although nearly acicular scales occur, but then in combination with strongly divided leaves.

1. *Davallia angustata* Hook. & Grev.

Davallia angustata Wall. ex Hook. & Grev., Icon. Filic. (1831) t. 231; Noot., Blumea 39 (1994) 173. — *Davallia angustifolia* (sic!) Roxb., Fl. Ind. 4 Crypt. (Calc. J. Nat. Hist. 4) (1844) 51. — *Humata angustata* J. Sm., J. Bot. 3 (1841) 415, 416; Copel., Fern Fl. Philipp. (1958) 179; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 367. — *Pachypleuria angustata* C. Presl, Epim. Bot. (1851) 98. — Type: Wallich 242 (K holo; BR, P), Roxburgh, Prince of Wales I.

Davallia attenuata Lodd., Cat. (1849). — *Humata attenuata* Alderw., Bull. Jard. Bot. Buitenzorg III, 5 (1922) 205. — Type: Bunnemeijer 5829 (BO holo; L), Riau Arch., P. Tuju.

Humata microsora Copel., Philipp. J. Sc., Bot. 7 (1912) 55, t. 4; Fern Fl. Philipp. (1958) 179. — Type: Weber 1146 (A, K, P), Mindanao, Butuan Subprov.

Humata mutata Alderw., Bull. Jard. Bot. Buitenzorg III, 5 (1922) 206. — Type: Bunnemeijer 6900 (BO holo; L), Lingga Arch., P. Lingga.

Humata angustata var. *hastata* C. Chr., Gard. Bull. Str. Settlm. 4 (1929) 398. — Type: Henderson 18256 (BM, SING), Peninsular Malaysia, Pahang, P. Tioman, G. Kajang.

Rhizome without the scales 1–2.5 mm diam., usually white waxy under the scales. Scales red-brown to nearly black, without pale border, narrowed evenly towards the apex, not or seldom curling backward, not bearing multiseptate hairs, toothed, peltate,

6–8 by 1 mm. *Stipes* pale to dark brown, adaxially grooved, 1–7 cm long, glabrous or with few scales. *Lamina* simple, entire to pinnatilobed, linear, glabrous, 5–24 by 6–20 cm, leaf not or slightly dimorphous. Margins distinctly crenulate to dentate at least towards the apex. False veins absent. *Sori* separate at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, semicircular, about as wide as long, 0.5–0.8 by 0.6–0.8 mm.

Distribution — Southern Thailand; *Malesia*: Sumatra, Peninsular Malaysia, Borneo, Philippines, SE Sulawesi; Pacific: Palau I., Baobetaob.

Habitat & Ecology — Epiphytic, often low on the tree bole, or epilithic. Altitude 0–1300 m.

2. *Davallia brassii* (Copel.) Noot.

Davallia brassii (Copel.) Noot., Blumea 39 (1994) 174. — *Humata brassii* Copel., Philipp. J. Sc. 73 (1940) 351, t. 5. — Type: Brass & Meijer Drees 9678 (L lecto; BM, K), Irian Jaya, Mt Trikora (= Wilhelmina).

Rhizome without the scales 1–1.5 mm diam., white waxy under the scales. Scales red-brown, without pale border, narrowed evenly towards the apex, often curling backward, not bearing multiseptate hairs, with marginal setae at least in distal part, peltate, 4–6 by 1 mm. *Stipes* dark brown, adaxially grooved, 1–17 cm long, glabrous or with few scales. *Lamina* compound, tripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 2–9.5 by 1.5–4 cm. Longest petiolules 1–3 mm long. Pinnae ovate. Longest pinnae 1–3.5 by 0.6–1.5 cm. Pinnules of at least the larger pinnae anadromous, rhomboid or linear oblong. Longest pinnules 4–15 by 3–5 mm. Ultimate leaflets linear oblong or rhomboid, lobed almost to the midrib. Ultimate segments or lobes obtuse or acute without a tooth, 1–3 by 0.5–0.8 mm. Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Veins in sterile ultimate lobes frequently simple, reaching the margin. False veins absent. *Sori* separate, frequently single on a segment, at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, more or less triangular to rhomboid, about as wide as long, 1 mm long and broad, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides or only at the outside of a sorus.

Distribution — *Malesia*: New Guinea (Irian Jaya: Lake Habbema, Mt Trikora, Ugumba; Papua New Guinea: West Sepik, Mt Capella).

Habitat & Ecology — Epiphyte. Altitude 3000–3400 m.

3. *Davallia brevipes* Copel.

Davallia brevipes Copel., Philipp. J. Sc., Suppl. 1 (1906) 147, t. 2; Fern Fl. Philipp. (1958) 172; Noot., Blumea 39 (1994) 175. — Type: Copeland 1662 (BM, P), Mindanao, San Ramon.

Davallia pullei Rosenst., Nova Guinea 8 (1912) 719. — Type: von Römer (Pulle) 214 (BO), New Guinea.

Rhizome without the scales 2–3.8 mm diam., white waxy under the scales. Scales red-brown, without pale border, narrowed evenly towards the apex, not or seldom curl-

ing backward, bearing multiseptate hairs at least when young, peltate, 7–9 by 1.5–2.5 mm. *Stipes* pale or dark brown, adaxially grooved, 2–13 cm long, bearing hairs and/or scales when young, or glabrous, or with few scales. *Lamina* compound, tripinnate towards the base and in the middle part, deltoid and broadest towards the base, bearing multicellular hairs, 8–23 by 5–14 cm, leaf not or slightly dimorphous. Longest petiolules 1–3 mm long. Pinnae deltoid. Longest pinnae 2.5–8 by 1.5–4.5 cm. Pinnules of at least the larger pinnae anadromous, linear oblong. Longest pinnules 10–30 by 3–10 mm. Ultimate leaflets linear oblong, lobed almost to the midrib. Ultimate segments or lobes acute and usually ending in a tooth, 0.5–4 by 0.3–1 mm. Upper ridge at the junction of the costa and pinna-rachis with a swollen lip. Leaf axes, at least rachises, hairy. Veins in sterile ultimate lobes simple or forked, reaching the margin. False veins absent. *Sori* separate, frequently single on a segment, at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide, 1–1.5 by 0.5 mm, upper margin elongated, free, extending to lamina margin or not. Lamina generally extending into a tooth at both sides of a sorus.

Distribution — *Malesia*: Philippines (Mindanao), C Sulawesi, Moluccas (Seram), New Guinea (Irian Jaya: Albatros bivak and Cyclops Mts; Papua New Guinea: E Highlands Prov., W Highlands Prov., Fly River, Morobe Prov., New Ireland, Bougainville); Pacific: Samoa, Upolu.

Habitat & Ecology — Epiphytic, often low on trees, or epilithic, sometimes in exposed places. Altitude 80–1100 m.

4. *Davallia corniculata* T. Moore

Davallia corniculata T. Moore, Index Fil. (1861) 292; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 359; Noot., Blumea 39 (1994) 177. — Type: *Lobb* 220 (K holotype; BM, L), Java.

Davallia epiphylla auct. non Spr.: Blume, Enum. Pl. Javae (1828) 235. — Based on *Blume* s.n. (Lsh 908.332-500).

Humata squarrosa Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 156. — Type: *Brooks* 460 S (BM), Sumatra.

Rhizome without the scales 3–4 mm diam., white waxy under the scales. Scales red-brown, without pale border, narrowed evenly towards the apex, often curling backward, not bearing multiseptate hairs, with marginal setae at least in distal part, peltate, 4–5 by 0.5–1 mm. *Stipes* dark brown, adaxially grooved, 9–30 cm long, glabrous or with few scales. *Lamina* compound, bipinnate or tripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 16–50 by 9–25 cm. Longest petiolules 2–4 mm long. Pinnae narrowly ovate. Longest pinnae 5–19 by 2–4.5 cm. Pinnules of at least the larger pinnae anadromous, linear oblong or narrowly ovate. Longest pinnules 12–25 by 3–10 mm. Ultimate leaflets linear oblong, lobed almost to the midrib, or only shallowly lobed. Ultimate segments or lobes obtuse or acute without a tooth, or acute and usually ending in a tooth, 0.5–7 by 1–2 mm. Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Margins of the lamina of each leaflet thickened and decurrent on the edge of the grooved rachis. Veins in sterile ultimate lobes pinnate, reaching the margin. False veins present. *Sori* separate, borne several on a segment, at the forking point of veins. Indusium attached at the

base and only part of the sides, or also attached along the sides, pouch-shaped, more or less triangular to rhomboid or oblong, about as wide as long, c. 0.5 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides or only at the outside of a sorus.

Distribution — Southern Thailand; *Malesia*: Sumatra, Peninsular Malaysia, W Java, Borneo (Sabah, Mt Kinabalu).

Habitat & Ecology — Epiphytic or epilithic, sometimes in rather dry places. Altitude 300–1800 m.

5. *Davallia denticulata* (Burm. f.) Kuhn

Davallia denticulata (Burm. f.) Mett. ex Kuhn, Filic. Deckén. (1867) 27; Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 286; Luerssen, Fil. Graeff. (1871) 215, non Mett.; Copel., Fern Fl. Philipp. (1958) 174; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 359; Noot., Blumea 39 (1994) 178. — *Adiantum denticulatum* [Pluk., Phytogr. 3 (1692) 151, t. 180, f. 4;] Burm. f., Fl. Indica (1768) 236; Houtt., Nat. Hist. (1783) 254, t. 100, f. 2. — *Trichomanes denticulatum* (Burm. f.) Houtt., Nat. Hist. (1783) t. 100, f. 2. — *Davallia elegans* Sw., J. Bot. (Schrader) 1800 (1801) 87, nom. illeg., Hedw., Fil. Gen. Sp. (1803); Blume, Enum. Pl. Javae (1828) 235. — *Trichomanes elegans* (Sw.) Poir., Leçons Fl. (1820) 79. — *Humata elegans* (Sw.) Desv., Prod. Fam. Foug. (1827) 324. — *Parestia elegans* (Sw.) C. Presl, Epim. Bot. (1851) 99. — Type: *Pryon s.n.* (n.v.), Java.

Distribution — Both of the varieties recognised occur in *Malesia*.

a. var. *denticulata*

Davallia denticulata (Burm. f.) Mett. ex Kuhn — *Adiantum denticulatum* Burm. f. — *Trichomanes denticulatum* (Burm. f.) Houtt. — *Davallia elegans* Sw. — *Trichomanes elegans* (Sw.) Poir. — *Humata elegans* (Sw.) Desv. — *Parestia elegans* (Sw.) C. Presl.

Davallia bidentata Schkuhr, 24 Kl. Linn. Pfl. Syst. 1 (1804) t. 127; Deutschl. Krypt. Gew. 1 (1809) 119, t. 127. — *Davallia elegans* Sw. var. *bidentata* Hook., Sp. Fil. (1845) 165. — Type: Schkuhr Fil. t. 127.

Davallia patens Sw., Syn. Fil. (1806) 132, 348. — *Humata patens* (Sw.) Desv., Prod. Fam. Foug. (1827) 325. — Type: *Rottler s.n.* (n.v.).

Trichomanes chaerophylloides Poir., Encycl. 8 (1808) 80. — *Davallia chaerophylloides* (Poir.) Steud., Nomencl. Bot. 2 (1824) 146. — *Humata chaerophylloides* (Poir.) Desv., Prod. Fam. Foug. (1827) 325. — Type: herb. DC. (n.v.).

Trichomanes lucidum Roxb., Calcutta J. Nat. Hist. 4 (1844) 519. — Type: *Wallich 253* (BR n.v.; K), Penang.

Davallia elegans Sw. var. *pulchra* Hook., Sp. Fil. (1845) 165. — Lectotype: *Lobb s.n.* (K), Singapore.

Davallia elegans Sw. var. *subunidentata* Hook., Sp. Fil. (1845) 165. — Type: *Zollinger 147* (K holo; BM, L, P).

Davallia impressa Copel., Univ. Calif. Publ. Bot. 14 (1929) 377. — Type: *Bartlett 6841* (A, K, L), Sumatra.

Rhizome without the scales 3–15 mm diam., not white waxy. Scales red-brown or nearly black, with pale border from base to apex or without pale border, narrowed evenly towards the apex or flat and nearly acicular, narrowed abruptly from a broad base, often curling backward, not bearing multiseptate hairs, toothed, peltate, 4–8 by 0.5–1.5 mm. *Stipes* pale, adaxially grooved, 4–50 cm long, glabrous or with few scales.

Lamina compound, bipinnate or quadripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 16–90 by 13–50 cm, leaf not or slightly dimorphous. Longest petiolules 4–35 mm long. Pinnae deltoid. Longest pinnae 8–45 by 5–30 cm. Pinnules of at least the larger pinnae anadromous, deltoid. Longest pinnules 70–200 by 40–110 mm. Ultimate leaflets linear oblong or narrowly ovate, lobed almost to the midrib or only shallowly lobed. Ultimate segments 5–27 by 2–6 mm. Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes pinnate (or forked in very narrow lobes), reaching the margin. False veins present. *Sori* separate, borne several on a segment, at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide or about as wide as long, 1–1.3 by 0.5–1 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides of a sorus.

Distribution — Generally common. Madeira, tropical and southern Africa, Madagascar, islands in the Indian Ocean (Comores, Seychelles, Christmas I.), Continental Asia: Sri Lanka, India (Assam, Andaman and Nicobar Is.), Thailand, Burma, China (Hainan), Indochina (Laos, Cambodia, Vietnam); throughout *Malesia*; Australia (Queensland); Pacific: Samoa, Society Is. (Tahiti).

Habitat & Ecology — Epiphyte on many different species of trees and in different types of forest incl. mangrove forest or on solitary trees, epilithic on granite, limestone, or sandstone, terrestrial on different kinds of soil, e.g. on sand in edge of kerangas forest. Altitude 0–2200 m.

b. var. *elata* (G. Forst.) Kuhn

Davallia denticulata (Burm. f.) Mett. ex Kuhn var. *elata* (G. Forst.) Mett. ex Kuhn in Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 288; Noot., Blumea 39 (1994) 180. — *Trichomanes elatum* G. Forst., Fl. Ins. Austr. (1786) n. 474. — *Davallia elata* (G. Forst.) Spreng., J. Bot. (Schrader) 1799 (2) (1800) 271. — *Wibelia elata* (G. Forst.) Bernh., J. Bot. (Schrader) 1801-I (1801) 122, t. 1, f. 2. — *Humata elata* (G. Forst.) Desv., Prod. Fam. Foug. (1827) 325. — *Parestia elata* (G. Forst.) C. Presl, Epim. Bot. (1851) 100. — Type: *Forster 474 (= 300)* (BM).

Davallia papuana Copel., Philipp. J. Sc., Bot. 6 (1911) 81. — Type: *King 245* (n.v.).

Davallia tenuisecta Copel., Philipp. J. Sc. 73 (1940) 355, t. 10. — Type: *Brass 11701* (A, BO, L), Irian Jaya.

Davallia dejoncheerii Hovenkamp & de Joncheere, Blumea 33 (1988) 408. — Type: *de Joncheere 1157* (L holotype), Celebes.

Differs from the typical variety in the upper margin of the indusium being elongated, free from the leaf margin or not and sometimes the indusium only attached at the base and part of the sides.

Distribution — *Malesia*: Philippines (Luzon), Sulawesi (P. Muna, Central, North), Moluccas (Buru, Banda, Babar, Seram, Halmahera, Ternate, Morotai, Aru Is.), New Guinea (Irian Jaya: Lorentz River, Albatros bivak, Balim River; Papua New Guinea: many collections); Pacific: Carolines, Solomon Is. (Bougainville), New Caledonia, New Hebrides, Fiji, Samoa, Rarotonga, Society Is.

Habitat & Ecology — Epiphytic, epilithic, or terrestrial on different kinds of soil, in forest and on exposed places. Altitude 0–1600 m.

Note — This variety could have its origin in hybridisation of *Davallia denticulata* var. *denticulata* with *D. embolostegia*. It has the same rhizome scales as *D. denticulata* var. *denticulata*. See also the note under *D. embolostegia*.

6. *Davallia divaricata* Blume

Davallia divaricata Blume, Enum. Pl. Javae (1828) 237; Copel., Fern Fl. Philipp. (1958) 173; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 362; Noot., Blumea 39 (1994) 180. — *Araiostegia divaricata* (Blume) M. Kato, Acta Phytotax. Geobot. 26 (1975) 158. — Type: *Blume s.n.* (L sh 908.333-153 holo; K), Java, G. Burangan.

Davallia mucronata Blume, Enum. Pl. Javae (1828) 235. — Type: *Kuhl & van Hasselt s.n.* (L sh 908.333-148 holo), Java, Bogor.

Davallia alata J. Sm., London J. Bot. 3 (1841) 417, nomen, non Blume. — *Davallia decurrens* Hook., Sp. Fil. (1845) 167, t. 44B; Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 54. — *Microlepia decurrens* (Hook.) Fée, Mém. Foug. 5. Gen. Filic. (1852) 326. — *Araiostegia decurrens* (Hook.) M. Kato, Acta Phytotax. Geobot. 26 (1975) 158. — Type: *Cuming 350* (K holo; BM, P), Philippines, Bohol.

Davallia polyantha Hook., Sp. Fil. (1845) 168, t. 59A. — *Microlepia polyantha* (Hook.) Fée, Mém. Foug. 5. Gen. Filic. (1850) 327. — Type: *Lobb s.n.* (K), Singapore.

Davallia lobbiana T. Moore, Index Fil. (1861) 296. — Type: *Lobb 1857* (K), Sarawak.

Davallia sumatrana Copel., Philipp. J. Sc., Bot. 9 (1914) 230. — Type: *Brooks 147* (BM, P), Sumatra.

Distribution — Both varieties recognised occur in Malesia.

a. var. *divaricata*

Davallia divaricata Blume — *Araiostegia divaricata* (Blume) M. Kato — *Davallia mucronata* Blume — *Davallia decurrens* Hook. — *Microlepia decurrens* (Hook.) Fée — *Araiostegia decurrens* (Hook.) M. Kato — *Davallia polyantha* Hook. — *Microlepia polyantha* (Hook.) Fée — *Davallia lobbiana* T. Moore — *Davallia sumatrana* Copel.

Rhizome without the scales 10–15 mm diam., not white waxy. Scales brown or red-brown without pale border, narrowed evenly towards the apex, curling backward or not, not bearing multiseptate hairs, toothed, basifixed with cordate base and greatly overlapping lobes, 5–20 by 2–4 mm. *Stipes* pale, adaxially grooved, 15–60 cm long, glabrous or with few scales. *Lamina* compound, tripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 60–100 by 40–70 cm. Longest petiolules 4–35 mm long. Pinnae deltoid. Longest pinnae 8–45 by 5–30 cm. Pinnules of at least the larger pinnae anadromous, deltoid. Longest pinnules 70–200 by 40–110 mm. Ultimate leaflets linear oblong or narrowly ovate, lobed halfway towards the midrib or only shallowly lobed. Ultimate segments 5–27 by 2–6 mm. Rachis adaxially distinctly grooved (often with a groove at either side). Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes pinnate (or forked in very narrow lobes), reaching the margin. False veins absent. *Sori* separate, borne several on a segment, at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, about as wide as long, c. 1 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides of a sorus.

Distribution — Continental Asia: from India to China (Yunnan, Fukien, Kwangsi, Guangdong, Taiwan, Hainan), southwards through SE Asia; throughout *Malesia*; Pacific: Solomon Is. (Bougainville, 1 collection).

Habitat & Ecology — Generally epiphytic, sometimes epilithic on limestone, or bed-rock not specified; rarely terrestrial. Mostly in dense forest, sometimes on dry places. Altitude 0–1850 m.

b. var. *dimorpha* (Holtum) Noot.

Davallia divaricata Blume var. *dimorpha* (Holtum) Noot., Blumea 39 (1994) 182. — *Davallia dimorpha* Holtum, Gard. Bull. Str. Settle. 9 (1937) 122; Revis. Fl. Malaya, ed. 2, 2 (1966) 362. — *Araiostegia dimorpha* (Holtum) M. Kato, Acta Phytotax. Geobot. 26 (1975) 158. — Type: *Holtum SF 31289* (SING holo; BM, BO, K), Malaya, Pahang, Cameron Highlands.

Lamina bipinnate or tripinnate towards the base and in the middle part, strongly dimorphous. *Lamina* of sterile leaves bipinnate or tripinnate, 40–60 by 25–50 cm. Longest pinnae 8–45 by 5–30 cm. Pinnules deltoid, 70–200 by 40–110 mm. *Lamina* of fertile leaves 40–60 by 25–50 cm, much more dissected than *lamina* of sterile leaves. Longest pinnae of fertile leaves 8–45 by 5–30 cm. Pinnules or pinnalobes deltoid, 70–200 by 40–110 mm. *Sori* separate, frequently single on a segment, at the forking point of veins. Indusium also attached along the sides, pouch-shaped, semicircular, 1 by 2 mm.

Distribution — *Malesia*: Sumatra (Eastcoast between Prapat and Pematang Siantar), Peninsular Malaysia (Pahang; Cameron Highlands).

Habitat & Ecology — Only once recorded: in crevices of rock in light shade. Altitude 400–1500 m.

Note — This is a local form of *Davallia divaricata* that was described by Holtum as a species. Except from the narrow segments of the fertile fronds and the broader indusia there are, however, no differences.

7. *Davallia embolostegia* Copel.

Davallia embolostegia Copel., Philipp. J. Sc., Suppl. 1 (1906) 147, t. 3; Fern Fl. Philipp. (1958) 171; Noot., Blumea 39 (1994) 182. — Type: *Copeland 1914* (n.v.), Luzon.

Rhizome without the scales 10–15 mm diam., not white waxy. Scales brown or red-brown without pale border, narrowed evenly towards the apex, curling backward or not, not bearing multiseptate hairs, toothed, basifixed with cordate base and greatly overlapping lobes, 5–20 by 2–4 mm. *Stipes* pale, adaxially grooved, 15–60 cm long, glabrous or with few scales. *Lamina* compound, tripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 60–100 by 40–70 cm, leaf not or slightly dimorphous. Longest petiolules 4–35 mm long. Pinnae deltoid. Longest pinnae 8–45 by 5–30 cm. Pinnules of at least the larger pinnae anadromous, deltoid. Longest pinnules 70–200 by 40–110 mm. Ultimate leaflets linear oblong or narrowly ovate, lobed halfway towards the midrib. Ultimate segments 5–27 by 2–6 mm. Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Margins of the *lamina* of each leaflet not thickened. Veins in sterile ultimate lobes pinnate (or forked in very narrow lobes), reaching the margin. False veins not present

(rarely present and plant like *D. denticulata* var. *elata*). *Sori* separate, borne several on a segment (if one on a lobe, the lobe not narrowed at base), at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide, 1–1.5 by 0.3–0.5 mm, upper margin elongated, free, protruding beyond lamina margin. Lamina generally extending into a tooth at both sides of a sorus.

Distribution — *Malesia*: Sumatra (Mt Sibeles), Borneo (Sarawak, Sabah, S Kalimantan), Philippines (Luzon, Negros, Samar, Mindoro), Moluccas (Seram, Bacan, Halmahera, Ternate, Morotai); Pacific: Samoa (Savai'i I.).

Habitat & Ecology — Epiphyte, generally in primary forest, sometimes epilithic. Altitude 0–2100 m.

Note — Hybridisation with *Davallia denticulata* is probably rather common; presumably collections with false veins are hybrids, sometimes they have the same shape of rhizome scales as *D. denticulata* but basally attached as in *D. embolostegia*.

8. *Davallia falcinella* (J. Sm.) C. Presl

Davallia falcinella (J. Sm.) C. Presl, Reliq. Haenk. 1 (1825) 66, t. 11, f. 2; Noot., Blumea 39 (1994) 183. — *Leucostegia falcinella* J. Sm., J. Bot. 3 (1841) 416. — *Acrophorus falcinellus* (J. Sm.) T. Moore, Index Fil. (1857) 2. — *Humata falcinella* (J. Sm.) Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 51. — *Trogostolon falcinellus* (J. Sm.) Copel., Fern Fl. Philipp. (1958) 170. — Type: *Hance s.n.* (PRC), Luzon.

Rhizome without the scales 2.5–3 mm diam., not white waxy. Scales nearly black, without pale border, distinctly acicular, often curling backward, not bearing multiseptate hairs, with marginal setae at least in distal part, peltate, 6–10 by 2 mm. *Stipes* dark brown, adaxially grooved, 4–9 cm long, glabrous or with few scales. *Lamina* compound, tripinnate or quadripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 7–14 by 6–14 cm. Longest petiolules 1–7 mm long. Pinnae linear-triangular. Longest pinnae 4–7 by 2–7 cm. Pinnules of at least the larger pinnae anadromous, linear oblong, or narrowly ovate. Longest pinnules 15–25 by 7–12 mm. Ultimate leaflets linear oblong, lobed almost to the midrib. Ultimate segments or lobes obtuse or acute without a tooth, 1–2 mm long (up to 4 mm in sterile leaves), 1–2 mm broad. Upper ridge at the junction of the costa and pinna-rachis not swollen. Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes frequently simple, not reaching the margin. False veins not present. *Sori* separate, frequently single on a segment, at the forking point of veins. Indusium attached at the base and only part of the sides, semicircular, about as wide as long, c. 1 mm. Lamina not extending into teeth beyond a sorus.

Distribution — *Malesia*: Philippines (Luzon, Mindanao, Leyte, Negros, Samar); Pacific: Marquesas Is.

Habitat & Ecology — Epiphyte. Altitude 0–800 m.

9. *Davallia heterophylla* Sm.

Davallia heterophylla Sm., Mém. Acad. Sci. Turin 5 (1793) 415; Noot., Blumea 39 (1994) 185. — *Humata heterophylla* (Sm.) Desv., Prod. Fam. Foug. (1827) 323; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 366. — Lectotype: *Charles Miller 1778* (BM).

[*Davallia lobulosa* Wall., Cat. (1828) n. 241, nomen]. — *Davallia longicauda* H. Christ, Bot. Jahrb. Syst. 23 (1896) 339. — Type: *Wallich 241* (K, P), Malaya, Penang.

Rhizome without the scales 1.8–2.4 mm diam., white waxy under the scales. Scales red-brown with pale border quickly diminishing or disappearing towards the apex, narrowed evenly towards the apex or flat and nearly acicular and narrowed abruptly from a broad base, curling backward (or appressed to rhizome, not crisped, only in the Pacific and New Guinea), not bearing multiseptate hairs, with marginal setae at least in distal part, peltate, 5–7 by 0.5–0.6 mm. *Stipes* pale, adaxially grooved or not, 0.5–7 cm long, glabrous or with few scales. *Lamina* simple, entire to pinnatilobed bearing multicellular hairs or glabrous, strongly dimorphous. Sterile lamina narrowly ovate (or ovate), 5–20 by 2–4.5 cm, margin flat or nearly so, not distinctly crenulate even towards the apex. Fertile lamina linear or rarely pinnatifid, 4–16 by 0.5–2.5 cm. False veins not present. *Sori* separate at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, semicircular, wider than long, 1 by 1.5–2.5 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not.

Distribution — Continental Asia: India (Nicobar Is.), Peninsular Thailand, S Vietnam; *Malesia*: Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands (Flores), Borneo, Philippines (Balabac, Paragua, Luzon, Catanduanes, Leyte, Samar, Mindanao), S Sulawesi (Lake Matano, Minahasa), Moluccas (Ambon, Seram, Aru Is., Banda), New Guinea; Pacific: Palau Is., Admiralty Is., Bougainville, Solomon Is., Carolines, Marianas, Guam, Fiji, Tonga, Samoa.

Habitat & Ecology — Epiphytic or epilithic, sometimes in swamp forest. Altitude 0–900 m (up to 2100 m, once recorded, Mt Kaindi in Papua New Guinea).

10. *Davallia hymenophylloides* (Blume) Kuhn

Davallia hymenophylloides (Blume) Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 286; Noot., Blumea 39 (1994) 15. — *Aspidium hymenophylloides* Blume, Enum. Pl. Javae (1828) 172. — *Leucostegia hymenophylloides* (Blume) Bedd., Ferns S. India (1863) t. 252. — *Humata hymenophylloides* (Blume) Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 51. — *Araiostegia hymenophylloides* (Blume) Copel., Philipp. J. Sc. 34 (1927) 241; Noot., Blumea 37 (1992) 171. — Type: *Blume s.n.* (Lsh 909.30–114), Java, Mt Burangran.

[*Leucostegia affinis* J. Sm., J. Bot. 3 (1841) 416, p.p., nomen]. — *Davallia affinis* Hook., Sp. Fil. (1845) 158, t. 52B. — *Microlepia affinis* (Hook.) C. Presl, Epim. Bot. (1851) 97. — *Acrophorus affinis* (Hook.) T. Moore, Proc. Linn. Soc. London 2 (1854) 286. — *Humata affinis* (Hook.) Mett., Fil. Hort. Bot. Lips. (1856) 102, t. 27, f. 5, 6. — Type: *Cuming 117* (K holo; A, BM, L, P), Philippines.

Microlepia tenuifolia C. Presl, Epim. Bot. (1851) 97. — Type: *Cuming 215* (A, BM, K, L, P), Philippines.

Cystopteris dalhousiana Fée, Mém. Foug. 8 (1857) 108. — Type: *Dalhousie* in Herb. Delessert (G holo; K), Penang.

Rhizome without the scales 3–20 mm diam., not white waxy. Scales brown (membranaceous), without pale border, narrowed evenly towards the apex, often curling backward, not bearing multiseptate hairs, lacking marginal setae or teeth or those rare, basifixed with cordate base and greatly overlapping lobes, 4–7 mm long. *Stipes* dark brown, adaxially grooved, 9–45(–65) cm long, glabrous or with few scales. *Lamina*



Fig. 1. *Davallia hymenophylloides* Blume (Ueda & Darnaedi B 8740).

compound, tripinnate, elongate, often narrowing towards the base, glabrous (or nearly so), 20–80(–90) by 6–50 cm, leaf not or slightly dimorphous. Longest petiolules 2.5–30 mm long. Pinnae linear-triangular. Longest pinnae 4–30(–44) by 1.5–15(–18) cm. Pinnules of at least the larger pinnae anadromous, narrowly ovate. Longest pinnules 10–80 by 5–20 mm. Ultimate leaflets linear oblong. Ultimate segments or lobes obtuse or acute without a tooth. Leaf axes glabrous (or nearly so). Veins in sterile ultimate lobes frequently simple, not reaching the margin. False veins not present. *Sori* separate, often single on a segment at the bending point of a vein. Indusium scaly, attached at the narrow cordate base only, reniform, wider than long, 0.1–0.4 by 0.4–0.7 mm. — **Fig. 1.**

Distribution — Continental Asia: Sri Lanka, India (W Ghats, Darjeeling), Thailand (Prachinburi); in *Malesia*: Sumatra (Westcoast, Tapanuli, Bengkulu, Eastcoast, Toba, Aceh), Peninsular Malaysia, Java, Lesser Sunda Islands (Flores), Borneo (Sarawak, Sabah, W, S & E Kalimantan), Philippines (Luzon, Mindanao, Mindoro, Biliran, Marinduque).

Habitat & Ecology — Epiphytic or epilithic, rarely terrestrial. Altitude 500–2200 m.

11. *Davallia parvula* Hook. & Grev.

Davallia parvula Wall. [Cat. (1828) n. 247, nomen] ex Hook. & Grev., Icon. Filic. (1829) t. 138; Noot., Blumea 39 (1994) 189. — *Acrophorus parvulus* (Hook. & Grev.) T. Moore, Proc. Linn. Soc. London 2 (1854) 286. — *Humata parvula* (Hook. & Grev.) Mett., Fil. Hort. Bot. Lips. (1856) 102, t. 27, f. 7, 8; Holtum, Revis. Fl. Malaya, ed. 2, 2 (1966) 369. — *Leucostegia parvula* (Hook. & Grev.) Bedd., Handb. Ferns Brit. India (1883) 54. — Type: Wallich 247 (K holotype; BM, L, P), Singapore.

Rhizome without the scales 0.5–1.2 mm diam., white waxy under the scales. Scales red-brown without pale border, narrowed evenly towards the apex, not or seldom curling backward, not bearing multiseptate hairs, with marginal setae at least in distal part, peltate, 2.5–6 by 0.3–0.6 mm. *Stipes* dark brown, adaxially grooved, 0.1–5 cm long, glabrous or with few scales. *Lamina* compound, entirely divided into fine linear segments without obvious rachis, deltoid and broadest towards the base, glabrous, 0.6–4 by 0.5–3.5 cm. Longest petiolules 1–2 mm long. Pinnules of at least the larger pinnae anadromous. Ultimate segments or lobes obtuse or acute without a tooth, 0.5–4 by 0.2–0.4 mm. Ultimate segments of sterile compound leaves 0.2–0.4 mm broad. Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Veins in sterile ultimate lobes frequently simple, reaching the margin. False veins not present. *Sori* separate, frequently single on a segment at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, semicircular or more or less triangular to rhomboid, about as wide as long, 0.3–0.8 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides of a sorus.

Distribution — *Malesia*: Sumatra (Eastcoast), Bangka, Lingga Archipelago, Singapore, Borneo (Sarawak, Brunei, Sabah, W, C & E Kalimantan), Papua New Guinea.

Habitat & Ecology — Epiphytic or epilithic. Altitude 0–800 m.

Note — *Davallia parvula* is closely related to *D. repens*. It is not easy to separate them; possible there are hybrids between some more dissected forms of *D. repens* and *D. parvula*.

12. *Davallia pectinata* Sm.

- Davallia pectinata* Sm., Mém. Acad. Sci. Turin 5 (1793) 415; Noot., Blumea 39 (1994) 189. — *Humata pectinata* (Sm.) Desv., Prod. Fam. Foug. (1827) 323; Copel., Fern Fl. Philipp. (1958) 178; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 369. — *Pachypleuria pectinata* (Sm.) C. Presl, Epim. Bot. (1849) 98. — Type: *D. Hurloch 1786* (n.v.), 'India Orientalis'.
- Nephrodium gaimardianum* Gaud. in Freyc., Voy. Uranie (1827) 335, t. 12, f. 1. — *Davallia gaimardiana* (Gaud.) C. Presl, Tent. Pterid. (1836) 128. — *Humata gaimardiana* (Gaud.) J. Sm., J. Bot. 3 (1841) 415. — Type: *Gaudichaud s.n.* (P), Île Rawak.
- Davallia intermarginalis* Blume, Enum. Pl. Javae (1828) 230. — *Pachypleuria intermarginalis* (Blume) C. Presl, Epim. Bot. (1851) 98. — *Humata intermarginalis* (Blume) T. Moore, Index Fil. (1861) 296. — Type: *Blume s.n.* (L sh 908.275-76), W Java.
- Prosaptia pinnatifida* C. Presl, Tent. Pterid. (1836) 166. — Type: *Meyen herb.* (n.v.), Luzon.
- Davallia multiflora* Roxb., Fl. Ind. 4 Crypt. (Calc. J. Nat. Hist. 4) (1844) 53. — *Davallia parallela* Wall. [Cat. (1828) n. 251, nomen] ex Hook., Sp. Fil. (1845) 153. — *Pachypleuria parallela* (Hook.) C. Presl, Epim. Bot. (1851) 98, pro spec. Philipp. — *Pteroneuron parallelum* (Hook.) Fée, Mém. Foug. 5. Gen. Filic. (1852) 320. — *Humata parallela* (Hook.) Brack., U.S. Expl. Exped., Filic. 16 (1854) 229. — Type: *Wallich 251* (K holo; P), Singapore.
- Davallia parallela* var. *a* Hook., Sp. Fil. 1 (1845) 153. — Type: *Cuming 61* (K holo; A, BM, L, P), Philippines.
- Humata lanuginosa* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 155. — Type: *Bünnemeijer 3881* (BO holo; K, L, P), Sumatra.
- Humata archboldii* Copel., Philipp. J. Sc. 73 (1940) 350, t. 4. — Type: *Brass 13301* (A, BM, BO, L), Irian Jaya.
- Humata tenuivenia* Copel., Philipp. J. Sc. 73 (1940) 350, t. 3. — Type: *Brass 14082* (A, BM, BO, L), Irian Jaya.

Rhizome without the scales 1.4–2.6 mm diam., white waxy under the scales. Scales red-brown, with pale border from base to apex, narrowed evenly towards the apex, not or seldom curling backward, bearing multiseptate hairs at least when young, peltate, 5 by 1.1–1.5 mm. *Stipes* pale or dark brown, adaxially grooved, 5–18 cm long, glabrous or with few scales. *Lamina* simple, one pectinate or pinnatifid leaf, narrowly ovate, elongate, often narrowing towards the base, bearing multicellular hairs or glabrous, 4–21 by 2.5–8 cm. Longest pinnae 1.5–3.2 by 0.3–0.5 cm. False veins not present. *Sori* separate at the forking point of veins or at the bending point of a vein. Indusium attached at the broad base and hardly or not at the sides, semicircular, wider than or about as wide as long, 0.6–0.8 by 0.6–1 mm, upper margin not elongated, truncate or slightly rounded, extending to the lamina margin or not. In some collections, e.g. *Brass 13301* (New Guinea) and *Posthumus s.n.* (Java), the scales are not hairy.

Distribution — Continental Asia: India (S Andaman, Nicobar Is.), China (Taiwan, Orchid I.), Thailand (southern?); **Malesia**: Sumatra, Peninsular Malaysia (Langkawi I., Kelantan, Pahang, Malacca, Johore), Singapore, Anambas Is., W Java, Borneo (Sarawak, Brunei, Sabah, W, S & E Kalimantan), Philippines (throughout but quite rare), N & C Sulawesi, Moluccas (Ambon, Seram, Talaud Is., Tanimbar Is., Aru Is., Ternate), Papua New Guinea incl. Bismarck Archipelago; Australia (N Queensland); Pacific: Truk Is., Solomon Is., New Hebrides, New Caledonia (Balade, Col d'Amos), Samoa, Carolines (Ponape), Cook Is. (Rarotonga, Mangaia), Austral Is., Ruruta, Society Is.

Habitat & Ecology — Epiphytic, epilithic, or sometimes terrestrial, on sand, lava, or limestone.

13. *Davallia repens* (L. f.) Kuhn

- Davallia repens* (L. f.) Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 286; Noot., Blumea 39 (1994) 192. — *Adiantum repens* L. f., Suppl. Pl. (1781) 446. — *Humata repens* (L. f.) Diels, Nat. Pflanzenfam. 1, 4 (1899) 209; Copel., Fern Fl. Philipp. (1958) 178; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 371. — Type: *Sonnerat par Thouin* (Commerson) 74 (P holo; L), Île de France.
- Davallia pedata* var. *minor* Nees & Blume, Nov. Act. Acad. Caes. Leop. Nat. Cur. 11 (1823) 122, t. 13, f. 1. — Type: *Blume s.n.* (n.v.).
- Davallia subimbricata* Blume, Enum. Pl. Javae (1828) 231. — *Pachypleuria subimbricata* (Blume) C. Presl, Epim. Bot. (1851) 261. — Type: *Blume s.n.* (L sh 908.275-807 holo), Java.
- Davallia alpina* Blume, Enum. Pl. Javae (1828) 231. — *Humata alpina* (Blume) T. Moore, Index Fil. (1857) 92. — Type: *Blume s.n.* (L sh.908.275-905 holo), Java, Mt Gedeh.
- Davallia vestita* Blume, Enum. Pl. Javae (1828) 233. — *Pachypleuria vestita* (Blume) C. Presl, Epim. Bot. (1851) 261. — *Humata vestita* (Blume) T. Moore, Index Fil. (1857) 92; Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 50; Fern Fl. Philipp. (1958) 177; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 370. — Type: *Blume s.n.* (L sh 908.275-969), Java, Mt Burangan.
- Davallia bipinnatifida* Blume, Enum. Pl. Javae (1828) 234. — *Humata bipinnatifida* (Blume) T. Moore, Index Fil. (1861) 290. — Type: *Blume s.n.* (?), Java.
- Davallia lepida* C. Presl [Tent. Pterid. (1836) 128, nomen] ex Goldmann, Nov. Act. Acad. Caes. Leop. Nat. Cur., Suppl. 1, 19 (1843) 464. — *Pachypleuria lepida* (Goldmann) C. Presl, Epim. Bot. (1851) 99. — *Humata lepida* (Goldmann) T. Moore, Index Fil. (1857) 92. — Type: *Meyen s.n.* (K), Philippines, Manila, 1831.
- Davallia cumingii* Hook., Sp. Fil. (1845) 155, t. 45B. — Type: *Cuming 138* (A, BM, K, L, P), Philippines, Samar.
- Davallia longula* Kunze, Bot. Zeitung (Berlin) 6 (1848) 215. — *Humata longula* (Kunze) T. Moore, Index Fil. (1861) 296. — Type: *Zollinger 3182* (BM, L), Java.
- Davallia repens* var. *bipinnatifida* Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 287. — Type: *Zollinger 3128* (n.v.), Java, Bandung.
- Davallia pinnatifida* Baker, J. Linn. Soc. Bot. 24 (1887) 257, non Sw. (1806). — *Humata intermedia* C. Chr., Index Filic. (1906) 353; Copel., Univ. Calif. Publ. Bot. 12 (1931) 401; Fern Fl. Philipp. (1958) 178. — Type: *Hose 179* (BM, K), Sarawak.
- Davallia bipinnatifida* Baker, Kew Bull. (1899) 119, nom. illeg., non Blume (1828). — Type: *Giulianetti & English s.n.* (K), New Guinea, Vanape Valley, 1897.
- Humata repens* var. *minuscula* C. Chr., Philipp. J. Sc., Bot. 3 (1908) 272. — *Humata minuscula* (C. Chr.) Alderw., Malayan Ferns Suppl. (1917) 216. — Type: *Ramos BS 1815* (P), Luzon, Rizal Prov.
- Humata introrsa* H. Christ, Nova Guinea 8 (1909) 160. — Type: *Versteeg 1279* (BO, K, L, P), Irian Jaya.
- Humata obtusata* Alderw., Bull. Jard. Bot. Buitenzorg II, 1 (1911) 8; Copel., Fern Fl. Philipp. (1958) 176. — *Pachypleuria obtusata* (Alderw.) M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 232. — Type: *MacGregor BS 8386* (BO holo; L, P), Luzon, Benguet Prov.
- Humata subtilis* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 17. — Type: *Schlechter 13788* (BO holo; BM, K), Papua New Guinea.
- Humata crassifrons* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 18. — Type: *Schlechter 14430* (BO holo; BM, K), Papua New Guinea, Torricelli Mts.
- Humata schlechteri* Brause, Bot. Jahrb. Syst. 49 (1912) 26. — Lectotype: *Schlechter 14430a* (BM iso), Papua New Guinea, Torricelli Mts.
- Humata subtilis* forma *major* Alderw., Bull. Jard. Bot. Buitenzorg II, 16 (1914) 17. — Type: *Exp. Hulstijn 261* (BO holo; L), Sumatra.
- Humata cromwelliana* Rosenst. in Fedde, Rep. 10 (1912) 324. — Type: *Bamler 8* (K, P, UC), Papua New Guinea, Cromwell.
- Humata perpusilla* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 17. — Lectotype: *Boerlage 346* (BO), Moluccas, Ambon, Mt Toena.

- Humata brooksii* Copel., Philipp. J. Sc., Bot. 7 (1912) 64. — Type: *Brooks 134* (BM), Borneo, Sarawak, Mt Poh.
- Humata puberula* Copel., Philipp. J. Sc., Bot. 7 (1912) 64. — Type: *Brooks 135* (n.v.), Sarawak, Mt Penrisen.
- Humata repens* forma *nana* Alderw., Bull. Jard. Bot. Buitenzorg II, 7 (1912) 17. — Type: *Docters van Leeuwen 15* (n.v.), Java, Tretes.
- Humata tenuis* Copel., Philipp. J. Sc., Bot. 7 (1912) 67. — Type: *King 367* (BM), New Guinea, Tamata.
- Humata kinabaluensis* Copel., Philipp. J. Sc., Bot. 12 (1917) 48. — Type: *Topping 1745* (A), Borneo, Sabah, Mt Kinabalu.
- Humata pusilloides* Copel., Sarawak Mus. J. 2 (1917) 338 (descr. in key); Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 26; Copel., Fern Fl. Philipp. (1958) 176. — Type: *Copeland 153* (BM, K, PNH, SING), Mindanao, Mt Matutum.
- Humata ledermannii* Brause, Bot. Jahrb. Syst. 56 (1920) 120. — Type: *Ledermann 9432* (BM iso), Papua New Guinea, Sepik.
- Humata kaudernii* var. *variabilis* C. Chr., Svensk Bot. Tidskr. 16 (1922) 98. — Type: *Kaudern 78* (BM, BO), Celebes.
- Humata wernerii* Copel., Univ. Calif. Publ. Bot. 12 (1931) 400, pl. 53B. — *Pachypleuria wernerii* (Copel.) M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 232. — Type: *Werner 17a* (UC, photo K), New Guinea, Mt Goh.
- Humata kinabaluensis* var. *subvestita* C. Chr., Gard. Bull. Str. Settle. 7 (1934) 232. — Type: *Holtum 25549* (BM, BO, K, SING), Borneo, Sabah, Mt Kinabalu.
- Humata mecodioides* Copel., Philipp. J. Sc. 73 (1940) 354, t. 8. — Type: *Brass 11691* (A, BM, BO, L), Irian Jaya, Balim River.
- Humata similis* Copel., Philipp. J. Sc. 73 (1940) 354, t. 9. — Type: *Brass 13365* (A, BM, BO), Irian Jaya, Idenburg River.
- Humata deltoidea* Copel., Philipp. J. Sc. 73 (1940) 352, t. 6. — Type: *Brass 13382* (A, BM, BO, L), Irian Jaya, Idenburg River.
- Humata papuana* Copel., Gen. Fil. 24 (1943) 441. — *Pachypleuria papuana* (Copel.) M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 231. — Type: *Brass 6987* (A, BM, L), New Guinea, Palmer River.
- Humata dissecta* Alston, Nova Guinea II, 7 (1956) 2. — *Pachypleuria dissecta* (Alston) M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 233. — Type: *C.J. Brooks 17571* (BM holo; BO), Ambon, Mt Toena.
- Humata pauxilla* Stone & Lane, Bot. Not. 112 (1959) 373, f. 1. — Type: *Stone, Gressitt & Alban 2441* (BISH holo; K).

Rhizome without the scales 0.5–3 mm diam., white waxy under the scales. Scales brown or red-brown, with pale border from base to apex or not, narrowed evenly towards the apex, not or seldom curling backward, bearing multiseptate hairs at least when young or with marginal setae at least in distal part, peltate, 2.5–7 by 0.3–1.5 mm. *Stipes* adaxially grooved, 0.1–18 cm long, glabrous or with few scales. *Lamina* compound (pinnate with pinnatilobed to pinnatifid pinnae, or bipinnate to quadripinnate towards the base and in the middle part), simple (one pectinate or pinnatifid leaf), 3-foliate (the leaflets more or less divided), or pinnate towards the base, ovate, deltoid and broadest towards the base, glabrous, 0.6–24 by 0.5–14 cm, leaf strongly dimorphous or not or slightly dimorphous. Longest petiolules 0–4 mm long. Pinnae linear-triangular, narrowly ovate, linear, or ovate to deltoid. Longest pinnae 1–10 by 0.6–7 cm. Pinnules (if present) of at least the larger pinnae anadromous, linear oblong or narrowly ovate. Longest pinnules 5–55 by 5–20 mm. Ultimate leaflets (if present) lobed almost to the midrib or only shallowly lobed. Ultimate segments or lobes obtuse or acute with-

out a tooth. In dimorphous plants lamina of fertile leaves pinnate with strongly dissected pinnae, bipinnate, or tripinnate towards the base and in the middle part. Longest petiolules of fertile leaves 1–7 mm long. Pinnae deltoid, linear-triangular, or narrowly ovate, 1–8 by 0.3–2.5 cm. Pinnules or pinnalobes deltoid, or linear-oblong, 2–35 by 1.5–15 mm. Ultimate leaflets linear oblong. Ultimate segments of fertile leaves 1–15 by 0.5–2 mm. Leaf axes glabrous. Veins in sterile ultimate lobes simple, forked, or pinnate, reaching the margin. False veins not present. *Sori* separate, borne several on a segment, or in much divided leaves frequently single on a segment, at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, semicircular or more or less triangular to rhomboid, wider than long or about as wide as long, 0.3–1 by 0.3–1.3 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides or only at the outside of a sorus, or not extending into teeth beyond a sorus.

Distribution — Africa: Cameroun, Gabon; Indian Ocean: Comores, Madagascar, Seychelles, Mascareignes, Réunion, Mauritius, Kerguelen, Bourbon I.; Continental Asia: Sri Lanka, throughout India, Sikkim, S Burma, China (Yunnan, Kwangsi, Kweichow, Quangdong incl. Hongkong, Kiangsi, Fukien, Hainan, Taiwan), Japan (Shikoku, Kyushu, Yakushima, Okinawa), Thailand, Cambodia, Vietnam; throughout *Malesia*; Australia (Queensland). Pacific: common in Admiralty Is., Solomon Is., New Hebrides, New Caledonia, Fiji, Samoa.

Habitat & Ecology — Very diverse. Low or high epiphytic, epilithic on various kinds of rocks, sometimes terrestrial. In very wet to dry sunny places. Altitude 0–3420 m.

Note — This is a very variable species, probably subject to hybridising and introduction of genes from several related species. Only in areas where no related species are found, like in China, the islands in the Indian Ocean, and in Africa, the pure form with pinnate to pinnatifid leaves occurs. In New Guinea the pure form is very rare. I have tried to subdivide the species in varieties. Although some forms are rather constant even over large areas, there are always many intermediate forms found between all the rather constant ones, making separation and identification of these forms impossible. The pure form is generally found at lower altitudes, the other forms higher, e.g., in W Java the pure form occurs from 450–1100 m, the other forms from 1400–2500 m. In Peninsular Malaysia this is from 150–1600 m and from 1400–2000 m, respectively. In Borneo, however, the pure form is found from 0–2500 m, the other forms from 100 to 3150 m. In the Philippines this is from 500–1350 m and from 400–2500 m, respectively.

14. *Davallia rouffaeriensis* Noot.

Davallia rouffaeriensis Noot., Blumea 39 (1994) 200. — Type: *Docters van Leeuwen 10277* (L holo; A, BO), Irian Jaya, Rouffaer River.

Rhizome without the scales 1.3–2.8 mm diam., white waxy under the scales or not. Scales brown, without pale border, narrowed evenly towards apex, often curling backward, not bearing multiseptate hairs, lacking marginal setae or teeth or those rare, or toothed, peltate, 4–6 by 0.8–1 mm. *Stipes* dark brown, adaxially grooved, 3–14 cm long, glabrous or with few scales. Lamina narrowly ovate, elongate, pinnate with pinnatilobed

to pinnatifid pinnae towards the base and in the middle part, glabrous, 10–22 by 3–6.5 cm. Pinnae linear-triangular. Longest pinnae 1.5–3.5 by 0.3–0.7 cm. False veins not present. *Sori* separate, frequently single on a segment at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, more or less triangular to rhomboid, about as wide as long, 0.4–0.6 by 0.4–0.6 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not.

Distribution — *Malesia*: Irian Jaya, Rouffaer River.

Habitat & Ecology — No data available.

15. *Davallia sessilifolia* Blume

Davallia sessilifolia Blume, Enum. Pl. Javae (1828) 231; Noot., Blumea 39 (1994) 2001. — *Pachypleuria sessilifolia* (Blume) C. Presl, Epim. Bot. (1851) 98. — *Humata sessilifolia* (Blume) Mett., Fil. Hort. Bot. Lips. (1856) 102. — Type: *Kuhl & van Hasselt s.n.* (L sh 908.275-915), Java, Mt Salak.

Rhizome without the scales 0.8–1.3 mm diam., white waxy under the scales. Scales red-brown with pale border from base to apex or not, narrowed evenly towards the apex, often curling backward, not bearing multiseptate hairs, toothed, peltate, 5–8 by 0.5 mm. *Stipes* pale, adaxially grooved, 0.5–7 cm long, glabrous or with few scales. *Lamina* simple, one pectinate or pinnatifid leaf, or pinnate towards the base, ovate, bearing multicellular hairs, or glabrous, 2–16 by 1.8–5 cm, leaf not or slightly dimorphous. False veins not present. Veins in ultimate lobes pinnate. *Sori* separate, borne several on a segment at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, semicircular, wider than long or about as wide as long, 1.1–1.8 by 1.2–1.8 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not.

Distribution — *Malesia*: Sumatra (Mt Kerinci), Java, Lesser Sunda Islands (Bali, Lombok, Flores), Borneo (E Kalimantan), Philippines (Luzon), C & N Sulawesi, Moluccas (Ternate), New Guinea; Pacific: Solomon Is., New Hebrides, Fiji.

Habitat & Ecology — Epiphytic from deep shade to full sun. Altitude 150–1770 m.

16. *Davallia sessilifolioides* M. Kato

Davallia sessilifolioides M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 227; Noot., Blumea 39 (1994). — Type: *Kato c.s. C-5336* (TI holo; BO, L), Moluccas, Ceram.

Rhizome without the scales 0.8–1.3 mm diam., white waxy under the scales. Scales red-brown, without pale border, narrowed evenly towards the apex, often curling backward, not bearing multiseptate hairs, toothed, peltate, 5–8 by 0.5 mm. *Stipes* pale or dark brown, adaxially grooved, 0.5–4.5 cm long, glabrous or with few scales. *Lamina* ovate, pinnate with pinnatilobed to pinnatifid pinnae towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 4–7 by 1.7–2.5 cm. Pinnae linear. Longest pinnae 0.8–1.5 by 0.3–0.8 cm. Ultimate leaflets lobed almost to or halfway towards the midrib, veins in ultimate lobes of sterile leaves single or forked. False veins not present. *Sori* separate, usually borne single on a segment at the forking point of veins. Indusium attached at the broad base and hardly or not at the sides, ovate or

semicircular, longer than wide, or about as wide as long, 1–1.2 by 0.8–1 mm, upper margin not elongated, truncate or slightly rounded, extending to the lamina margin or not.

Distribution — *Malesia*: Moluccas (Seram, Manusela Nat. Park).

Habitat & Ecology — Altitude 200–1000 m.

Note — This species is closely related to *D. sessilifolia*, mainly differing in the more dissected leaves.

17. *Davallia solida* (G. Forst.) Sw.

Davallia solida (G. Forst.) Sw., J. Bot. (Schrader) 1800 (1801) 87; Copel., Fern Fl. Philipp. (1958) 173; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 360; Noot., Blumea 39 (1994) 202. — *Trichomanes solidum* G. Forst., Fl. Ins. Austr. (1786) 86. — *Humata solida* (G. Forst.) Desv., Prod. Fam. Foug. (1827) 324. — *Stenolobus solidus* (G. Forst.) C. Presl, Tent. Pterid. (1836) 130. — Type: *Forster* 308 (BM holo; P), Pacific Islands.

Davallia caudata Cav., Descr. Pl. (1802) 279. — *Parestia caudata* (Cav.) C. Presl, Epim. Bot. (1851) 100. — Type: *Née* (n.v.), Philippines.

Davallia procera Hedw., Fil. Gen. Sp. (1803) t. 24, acc. to Index Filicum.

Davallia splendens Blume, Enum. Pl. Javae (1828) 234. — Type: *Reinwardt s.n.* (L sh 908.332-920 holo), Banda.

Stenolobus ornatus C. Presl, Tent. Pterid. (1836) 130. — [*Davallia ornata* Wall., Cat. (1828) n. 246, nomen.] — *Davallia solida* (G. Forst.) Sw. var. *latifolia* Hook., Sp. Fil. (1846) 163. — *Davallia solida* (G. Forst.) Sw. var. *ornata* (C. Presl) Mett. ex Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 286. — Type: *Wallich* 246 (K holo; P), Malaya, Penang.

Davallia solida forma *tomentella* Rosenst. in Fedde, Rep. 13 (1914) 213. — Type: *Grasshoff* 43 (n.v.).

Davallia elmeri Copel., Leaf. Philipp. Bot. 9 (1920) 3107; Fern Fl. Philipp. (1958) 174. — Type: *Elmer* 16234 (A, BM, BO), Luzon, Mt Bulusan.

Davallia robinsonii Copel., Philipp. J. Sc. 30 (1926) 326; Fern Fl. Philipp. (1958) 173. — Type: *Robinson* BS 11704 (P), Mindanao, Cota Bato.

Davallia subsolida Ching, Fl. Reip. Popul. Sin. 2 (1959) 376. — Type: *Kudo & Susuki* 15996 (n.v.), Taiwan.

var. *solida*

Rhizome without the scales 4–14 mm diam., not white waxy. Scales red-brown or nearly black (the peltate base black, persistent when the rest of the scale is shed) with pale border from base to apex, narrowed evenly towards the apex or above the much broader base evenly narrowed towards the apex, not or seldom curling backward, bearing multiseptate hairs at least when young (hairs at least at the apex of young scales, c. 1 mm long, woolly), peltate, 5–10 by 1–1.2 mm. *Stipes* pale, adaxially grooved, 9–35 cm long, glabrous or with few scales. *Lamina* compound, bipinnate or tripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous (sometimes with hairs on junction of rachis and petiolule), 15–90 by 21–40 cm, leaf not or slightly dimorphous. Longest petiolules 5–25 mm long. Pinnae linear-triangular or narrowly ovate. Longest pinnae 11–28 by 6–15 cm. Pinnules of at least the larger pinnae anadromous, deltoid or rhomboid. Longest pinnules 4–10 by 1.5–8 cm. Ultimate leaflets linear oblong or rhomboid, lobed almost to the midrib, or only shallowly lobed (in bipinnate leaves the ultimate segments shallowly lobed). Ultimate segments 10–40 by 3–17 mm. Upper ridge at the junction of the costa and pinna-rachis not swollen.

Leaf axes glabrous (often hairs at junction of petiolules). Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes pinnate, reaching the margin or not. False veins not present. *Sori* separate, borne several on a segment at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide, 1.2–2 by 0.5–1 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina not extending into teeth beyond a sorus.

Distribution — Continental Asia: Sri Lanka, India (Assam, Khasia, Andaman & Nicobar Is.), Burma, Thailand, S Cambodia, China (Yunnan, Kwangsi, Taiwan), Vietnam (Tonkin, Cochinchina); *Malesia*: Sumatra, Peninsular Malaysia, Anambas & Natuna Is., Java, Lesser Sunda Islands (Sumba, Flores), Borneo (Sarawak, Brunei, Sabah, C, S & E Kalimantan), Philippines and Moluccas common throughout, New Guinea; Pacific: common from the Bismarck Archipelago to the Santa Cruz Is., Samoa and the Society Is. and to the New Hebrides, New Caledonia, Fiji, and Tonga.

Habitat & Ecology — Epiphytic, epilithic on different kinds of rock, or terrestrial on different kinds of soil; as well in exposed places as in deep shadow, from open rocky places and savannas to primary rain forest. Altitude 0–1500 m.

Note — Sometimes the leaf segments are very narrow and the plant resembles var. *fejeensis* (Hook.) Noot. from Fiji and the Austral Islands. A third variety, var. *pyxidata* (Cav.) Noot., occurs in Australia (Queensland and New South Wales).

18. *Davallia trichomanoides* Blume

Davallia trichomanoides Blume, Enum. Pl. Javae (1828) 238; Copel., Fern Fl. Philipp. (1958) 172; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 361; Noot., Blumea 39 (1994) 206. — Type: *Blume s.n.* (L sh 908.332-946 holo), Java.

Davallia stenomera Kunze, Bot. Zeitung (Berlin) 6 (1848) 216. — Type: *Zollinger 359* (L).

Davallia fructuosa H. Christ in Warb., Monsunia 1 (1900) 86. — Type: *Warburg* (n.v.), Java.

Davallia barbata Alderw., Bull. Jard. Bot. Buitenzorg II, 2 (1913) 7. — *Davallia subdissecta* Alderw., Bull. Jard. Bot. Buitenzorg II, 23 (1916) 11, nom. illeg. — *Davallia trichomanoides* Blume forma *barbata* (Alderw.) Backer & Posth., Varenfl. Java (1939) 101. — Type: *Hallier 671* (BO holo; P), Java.

Davallia koordersii Alderw., Bull. Jard. Bot. Buitenzorg II, 1 (1911) 5. — Type: *Koorders 19387* (BO lecto; L), Java, Idjen.

Davallia subdissecta Alderw. var. *elegantior* Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 17. — Type: *Backer 23827* (BO holo), Java, Mt Sanggaboewana.

Davallia subdissecta Alderw. var. *subgenuina* Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 140. — Type: *Lörzing 5925* (BO holo; K, L), Sumatra, Karo Plateau.

a. var. *trichomanoides*

Rhizome without the scales 3–8 mm diam., not white-waxy. Scales brown or red-brown, with pale border from base to apex or not, flat and nearly acicular, narrowed abruptly from a broad base or above the much broader base evenly narrowed towards the apex, often curling backward or appressed to rhizome, usually crisped, margins recurved, not bearing multiseptate hairs, with marginal setae at least in distal part or toothed, peltate, 4–8 by 1–1.5 mm. *Stipes* pale, adaxially grooved, 4.5–20 cm long, glabrous or with few scales. *Lamina* compound, tripinnate or quadripinnate towards the base and in the middle part, deltoid and broadest towards the base, glabrous, 10–35 by 9–25 cm.

Longest petiolules 1–6 mm long. Pinnae deltoid, longest 5–19 by 3–12 cm. Pinnules of at least the larger pinnae anadromous, narrowly ovate, longest 2–7 by 1–3 cm. Ultimate leaflets linear oblong or narrowly ovate, lobed almost to the midrib. Ultimate segments 5–27 by 2–6 mm. Upper ridge at the junction of the costa and pinna-rachis not swollen. Leaf axes glabrous. Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes simple or forked, not reaching the margin. False veins present, rarely absent. *Sori* separate, frequently single on a segment at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide, 1.2–2 by 0.5–1 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth at both sides of a sorus or only at the outside of a sorus.

Distribution — Continental Asia: India (Kerala, Darjeeling, Assam and eastern Himalayas), Nepal, Sikkim, Burma, N & C Thailand, China (Yunnan, Shantung, Shanghai), Korea, Japan common from Ryukyu in the south to Honshu in the north, Vietnam (Annam, Lang Bian, Tonkin); *Malesia*: Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands, Sulawesi (C, N, SW), Moluccas (Buru, Seram), New Guinea.

Habitat & Ecology — Epiphytic and epilithic on different kinds of rock, mostly in wet places, sometimes on dry, exposed places. Altitude 100–3500 m.

b. var. *lorrainii* (Hance) Holttum

Davallia trichomanoides Blume var. *lorrainii* (Hance) Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 361; Noot., Blumea 39 (1994) 207. — *Davallia lorrainii* Hance, Ann. Sci. Nat. Bot. 5 (1866) 254. — Type: *Lorrain 1732* (BM), Malaya, Penang.

Scales nearly black with highly contrasting white setae, 4–8 by 1.2–2 mm. Indusium 1–1.5 mm long, 1 mm broad.

Distribution — Continental Asia: India (Kerala), Thailand, Cambodia, Vietnam; *Malesia*: Sumatra (Aceh, Westcoast, Eastcoast), Peninsular Malaysia (Kedah, Penang, Selangor, Negri Sembilan), Java? (1 coll.), Borneo (Sabah, E Kalimantan), Philippines (Luzon, Bohol, Uma, Mindanao), C Sulawesi.

Habitat & Ecology — Epiphytic or epilithic, mostly in wet places but sometimes in exposed, dry places and savanna. Altitude 100–1800 m.

19. *Davallia wagneriana* Copel.

Davallia wagneriana Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 54; Fern Fl. Philipp. (1958) 172; Noot., Blumea 39 (1994) 208. — Type: *Copeland 1300* (P), Mindanao.

Rhizome without the scales 2–6 mm diam., white waxy under the scales. Scales brown, red-brown, or nearly black, without pale border, narrowed evenly towards the apex, not or seldom curling backward, bearing (woolly) multiseptate hairs at least when young, peltate, 6–8 by 1.5–2 mm. *Stipes* dark brown, adaxially grooved, 8–26 cm long, glabrous or with few scales. *Lamina* compound, bipinnate or pinnate with pinnatilobed to pinnatifid pinnae towards the base and in the middle part, deltoid and broadest towards the base or elongate, glabrous, 10–44 by 5–20 cm, leaf not or slightly dimorphous (but pinnulae of fertile leaves very narrow). Longest petiolules 1–4 mm long.

Pinnae linear-triangular (curved upwards). Longest pinnae 4–13 by 1.5–3 cm. Pinnules of at least the larger pinnae anadromous. Pinnules or pinna lobes linear oblong. Longest pinnules 10–15 by 2–3 mm. Ultimate leaflets linear oblong, only shallowly lobed. Upper ridge at junction of costa and pinna-rachis not swollen. Leaf axes glabrous. Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes pinnate, reaching the margin. False veins present or not. *Sori* separate, borne several on a segment at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide or about as wide as long, 1 by 0.5–1 mm. Indusium lips or upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not. Lamina generally extending into a tooth only at the outside of a sorus.

Distribution — *Malesia*: Sumatra, Borneo (Sarawak, E Kalimantan), Philippines (Luzon, Panay, Mindanao, Negros, Leyte), N Sulawesi, Moluccas (Seram).

Habitat & Ecology — Epiphyte in deep shadow (only few times recorded). Altitude 450–1600 m.

Section *Scyphularia*

Davallia sect. *Scyphularia* (Fée) Noot., Blumea 39 (1994) 208. — *Scyphularia* Fée — *Parasorus* Alderw.

For a more detailed synonymy, see under the genus.

This section is characterised by a combination of characters not occurring in the type section. The rhizome scales are acicular, the leaves simple or imparipinnate (leaves or leaflets about linear), and the indusia are pouch-shaped or (in *D. undulata*) connate into a coenosorus.

20. *Davallia pentaphylla* Blume

Davallia pentaphylla Blume, Enum. Pl. Javae (1828) 232; Noot., Blumea 39 (1994) 209. — *Stenolobus pentaphyllus* (Blume) C. Presl, Epim. Bot. (1851) 99. — *Scyphularia pentaphylla* (Blume) Fée, Mém. Foug. 5. Gen. Fil. (1852) 325, t. 26B, f. 1. — Type: *Blume s.n.* (L sh 908.332-859 holo; K), Java, Bantam.

Davallia pentaphylla Blume var. *incisa* Rosenst., Hedwigia 56 (1915) 351. — Type: *Bamler 105* (P), Papua New Guinea, Wareo.

Scyphularia sinusora Copel., Philipp. J. Sc. 34 (1927) 255, t. 5. — Type: *Copland King 183* (n.v.), Papua New Guinea, Goodenough Bay.

Scyphularia dorsalis Copel., Univ. Calif. Publ. Bot. 12 (1931) 401. — Type: *Bamler 34* (UC; K photo), Papua New Guinea, Sattelberg.

Rhizome without the scales 2–4 mm diam., not white waxy. Scales nearly black with pale border quickly diminishing or disappearing towards the apex, distinctly acicular, often curling backward, bearing multiseptate hairs at least when young, peltate, 6–10 mm long. *Stipes* dark brown, adaxially grooved, 2–17 cm long, glabrous or with few scales. *Lamina* imparipinnate, leaflets entire or nearly so, occasionally lobed at the base or once branched (pairs of leaflets 2, occasionally 3 or 4), glabrous. Leaflets entire or nearly so, sometimes with some basal lobes. Sterile terminal leaflet 2.5–16 by 13–25 mm. Lateral leaflets 2.5–12 by 0.8–2.5 cm. Margin flat or nearly so, distinctly crenulate to dentate at least towards the apex. Petiolules 0–4 mm long. Leaflets of fertile

leaves entire or nearly so, sometimes with some basal lobes. Fertile terminal leaflet 8–19 by 0.7–1.5 cm. Lateral leaflets 4–14 by 0.4–1.2 cm. Margins distinctly crenulate to dentate at least towards the apex. Longest petiolules of the fertile leaves 0–4 mm long. Pinnæ narrowly ovate or linear (narrowly). Leaf axes glabrous. Margins of the lamina of each leaflet not thickened. Veins in sterile ultimate lobes parallel, once or twice branched from the base, reaching the margin. False veins not present. *Sori* separate (sometimes nearly connate, in a band along the margin) at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide, 1.5–2.5 by 0.75–2 mm, upper margin not elongated, truncate or slightly rounded, separated from to even with lamina margin.

Distribution — *Malesia*: Sumatra (Mt Kerinci, Bengkulu), Bangka, throughout Java, Lesser Sunda Islands (Bali, Flores, Sumbawa), Borneo (Sarawak, E & S Kalimantan), Sulawesi (N, C & SW), Moluccas (Ternate, Seram), New Guinea; Pacific: Bougainville, Solomon Is., New Hebrides, Fiji.

Habitat & Ecology — Epiphytic or epilithic on different kinds of rock, rarely terrestrial. Altitude 150–3200 m, but rarely at lower altitudes.

21. *Davallia seramensis* M. Kato

Davallia seramensis M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 223; Noot., Blumea 39 (1994) 210. — Type: Kato, Ueda & Mahjar C-1276 (TI holo; BO, L), Ceram.

Rhizome without the scales 1–2 mm diam., white waxy. Scales nearly black, with pale border quickly diminishing or disappearing towards the apex, distinctly acicular, often curling backward, not bearing multiseptate hairs, with marginal setae at least in distal part, peltate, 3–5 mm long. *Stipes* 1–1.5 cm apart, dark brown, not grooved, 3–7 cm long, glabrous or with few scales. *Lamina* simple, entire to pinnatilobed, glabrous, 8–13 by 0.6–1.5 cm, leaf not or slightly dimorphous. Leaves entire or nearly so, sometimes with some basal lobes, linear. Margin flat or nearly so, not distinctly crenulate even towards the apex. Fertile leaves entire or nearly so, sometimes with some basal lobes, linear. Margins not distinctly crenulate even towards the apex. Veins in sterile leaves parallel, once or twice branched from the base, reaching the margin. False veins not present. *Sori* separate, at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, about as wide as long, c. 1 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not.

Distribution — *Malesia*: Sulawesi (Minahasa, Mt Soputan), Moluccas (Seram), New Guinea (Irian Jaya, Mt Badurti).

Habitat & Ecology — Epiphyte. Altitude 0–1200 m.

22. *Davallia triphylla* Hook.

Davallia triphylla Hook., Sp. Fil. (1845) 162, t. 46a; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 357; Noot., Blumea 39 (1994) 210. — *Stenolobus triphyllus* (Hook.) C. Presl, Epim. Bot. (1851) 99. — *Scyphularia triphylla* (Hook.) Fée, Mém. Foug. 5. Gen. Filic. (1852) 324. — Type: *Cuming* 366 (K holo; P), Singapore.

Scyphularia simplicifolia Copel., Philipp. J. Sc., Bot. 7 (1912) 64. — *Davallia simplicifolia* (Copel.) C. Chr., Index Filic. Suppl. (1913) 23. — Type: *Brooks* 133 (BM), Sarawak, Mt Santubong.

Rhizome without the scales 2–5 mm diam., not white waxy. Scales nearly black, with pale border quickly diminishing or disappearing towards the apex, distinctly acicular, appressed to rhizome, not crisped, bearing multiseptate hairs at least when young, peltate, 5 mm long. *Stipes* dark brown, adaxially grooved, 2–8 cm long, glabrous or with few scales. *Lamina* imparipinnate, leaflets entire or nearly so, occasionally lobed at the base or once branched, or simple, entire to pinnatilobed, glabrous. Leaflets entire or nearly so, sometimes with some basal lobes. Sterile terminal leaflet or simple leaf 9–35 by 1–4 cm. Lateral leaflets 6–9 by 0.6–2.5 cm. Margin recurved or revolute, distinctly crenulate to dentate at least towards the apex. Pinnae narrowly ovate. Leaflets of fertile leaves entire or nearly so, sometimes with some basal lobes, or pinnatifid. Fertile terminal leaflet or simple leaf 8–28 by 1–4.5 cm. Lateral leaflets 4–8 by 0.7–2 cm. Margins distinctly crenulate to dentate at least towards the apex or not. Pinnae narrowly ovate or linear. Veins in sterile leaflets parallel, once or twice branched from the base, reaching the margin. False veins not present. *Sori* separate at the forking point of veins. Indusium also attached along the sides, pouch-shaped, oblong, longer than wide, 2 by 0.5–0.75 mm, upper margin not elongated, truncate or slightly rounded, extending to lamina margin or not, or protruding beyond lamina margin.

Distribution — *Malesia*: Sumatra (Aceh, Riau, Indragiri, Jambi), Peninsular Malaysia (Perak, Selangor, Trengganu, Negri Sembilan, Johore), Singapore, Borneo (Sarawak, Sabah, E Kalimantan).

23. *Davallia undulata* (Alderw.) Noot.

Davallia undulata (Alderw.) Noot., *Blumea* 39 (1994) 211. — *Parasorus undulatus* Alderw., Bull. Jard. Bot. Buitenzorg III, 4 (1922) 317. — Type: *Beguin 1321* (BO holo; L), Moluccas, Ternate.

Rhizome without the scales 1.5–2 mm diam., not white waxy. Scales nearly black, without pale border, distinctly acicular, often curling backward, not bearing multiseptate hairs, lacking marginal setae or teeth or those rare, peltate, 3–5 mm long. *Stipes* dark brown, not grooved, 2.5–5 cm long (winged towards the apex), glabrous or with few scales. *Lamina* simple, entire, glabrous, 6–17 by 1 cm, leaf not or slightly dimorphous. Fertile leaf 7–20 mm broad. Veins in sterile leaves parallel, once or twice branched from the base. *Sori* and indusia connate, elongate along leaf margins.

Distribution — *Malesia*: Moluccas (Halmahera and Ternate, Mt Sembilan).

Habitat & Ecology — Epiphyte. Altitude 600 m.

DAVALLODES

Davallodes Copel., Philipp. J. Sc., Bot. 3 (1908) 33; Fern Fl. Philipp. (1958) 168; Noot., *Blumea* 37 (1992) 176. — *Microlepidia* sect. *Davallodes* Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 55. — Type species: *Davallodes hirsutum* (C. Presl) Copel.

Rhizome bearing only scales. Roots restricted to the ventral side of the lateral buds. Scales yellowish, light brown, or nearly black, with pale border extending from base to apex, quickly diminishing or disappearing into the apex, or without pale border, not bearing multicellular hairs, lacking marginal setae (or with marginal setae in *D. novo-*

guineense), entire, smooth on adaxial surface, peltate, or basifixed with a cordate base with greatly overlapping lobes (in *D. viscidulum* and *D. urceolatum*). *Stipe* articulated on phyllopodia, grooved, bearing hairs and/or scales when young. *Lamina* compound, pinnate with strongly dissected pinnae or bipinnate towards the base and in the middle part, elongate and narrowed towards the base, bearing multicellular hairs, not or slightly dimorphous. Hairs between veins on each surface present or not. Pinnae linear-triangular. Pinnulae or pinna lobes linear oblong. Ultimate segments obtuse, without a dominant tooth. Pinnules of at least the larger pinnae catadromous. Rachis adaxially raised. Leaf axes, at least rachises, hairy. Veins in ultimate lobes simple or forked, not reaching the margin. False veins wanting. *Sori* indusiate, separate, frequently single on a segment, facing midveins at the forking point of veins or (rarely) at the bending point. Indusium scaly, attached at the narrow, cordate base only, or attached at the base and only part way up at the sides, or also attached along the sides, pouch-shaped, or attached at the broad base and hardly or not at the sides, or very small, inconspicuous. — **Fig. 2.**

Distribution — Six species restricted to S Thailand (one species) and *Malesia*.

KEY TO THE SPECIES

- 1a. Indusium scaly, attached at the narrow, cordate base only 2
- b. Indusium attached at the base and only part of the sides or also attached along the sides and pouch-shaped, or only attached at broad base and hardly or not at sides, or very small and inconspicuous 3
- 2a. Leaves usually bipinnate. Indusium semicircular or oblong; scales basifixed with cordate base and greatly overlapping lobes, longest petiolules 1 mm long, longest pinnules or pinna lobes 15–32 by 3–10 mm, indusium longer than wide or about as wide as long **6. *D. viscidulum***
- b. Leaves usually pinnate with strongly dissected pinnae. Indusium reniform, wider than long; scales peltate; longest petiolules 2–3 mm long; longest pinnules or pinna lobes 12–17 by 3–5 mm **1. *D. borneense***
- 3a. Indusium attached at the broad base and hardly or not at sides, semicircular, wider than long; scales with pale border from base to apex or this quickly diminishing or disappearing towards the apex, flat and nearly acicular ... **3. *D. novoguineense***
- b. Indusium attached at the base and only part of the sides or also attached along the sides, pouch-shaped, or very small, inconspicuous, more or less triangular to rhomboid or oblong, longer than wide or about as wide as long; scales without pale border, distinctly acicular 4
- 4a. Indusium very small, inconspicuous **2. *D. hirsutum***
- b. Indusium conspicuous, attached at the base and only part of the sides or also attached along the sides, pouch-shaped 5
- 5a. Scales basifixed with cordate base and much overlapping lobes **5. *D. urceolatum***
- b. Scales peltate 6
- 6a. Indusium longer than wide with free pointed upper half, at least as long as basal half **4. *D. seramense***
- b. Indusium longer than wide or about as wide as long, without free pointed upper half **2. *D. hirsutum***

1. *Davallodes borneense* (Hook.) Copel.

Davallodes borneense (Hook.) Copel., Sarawak Mus. J. 2 (1917) 336; Noot., Blumea 37 (1992) 178. — *Lastrea borneensis* Hook., Icon. Pl. (1854) t. 993. — *Nephrodium borneensis* (Hook.) Hook., Sp. Fil. 4 (1862) 111. — *Leucostegia borneensis* (Hook.) J. Sm., Ferns Brit. For. (1866) 77. — *Davallia borneensis* (Hook.) Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 286. — *Dryopteris borneensis* (Hook.) Kuntze, Revis. Gen. Pl. 2 (1891) 812. — Type: *Lobb s.n.* (K), Borneo 1857.

Davallia nephrodioides Baker, J. Linn. Soc. Bot. 24 (1887) 257. — *Humata nephrodioides* (Baker) Alderw., Malayan Ferns (1909) 295. — *Leucosiëgia nephrodioides* (Baker) Copel., Sarawak Mus. J. 2 (1917) 336. — *Davallodes nephrodioides* (Hook.) Copel., Philipp. J. Sc. 34 (1927) 249. — Type: *Hose s.n.* (K holo; BM, P), Sarawak.

Rhizome without the scales 5–10 mm diam. Scales nearly black, with pale border abruptly diminishing or disappearing towards the apex or without pale border, distinctly acicular or flat and nearly acicular, lacking marginal setae or setae rare, peltate, 5–13 mm long. **Stipes** 9–30 cm long. **Lamina** compound, pinnate with strongly dissected pinnae towards the base and in the middle part, bearing multicellular hairs, 16–75 by 9–26 cm, lower pinnae not very small, about one third to about as long as longest ones. Hairs between veins on either surface absent or nearly so. Longest petiolules 2–3 mm long. Longest pinnae 5–14 by 1.5–4 cm. Longest pinnules or pinna lobes 12–17 by 3–5 mm. Hairs on leaf axes 0.5 mm long. **Indusium** scaly, attached at the narrow, cordate base only, reniform, wider than long, 0.3–0.5 by 0.75–1 mm.

Distribution — S Thailand; **Malesia**: Borneo (E & S Kalimantan, Sarawak, Sabah).

Habitat & Ecology — On tree trunks in wet places, along rivers etc. in deep shade. From sea level to 1500 m altitude.

2. *Davallodes hirsutum* (C. Presl) Copel.

Davallodes hirsutum (J. Sm. ex C. Presl) Copel., Philipp. J. Sc., Bot. 3 (1908) 33; Fern Fl. Philipp. (1958) 169; Noot., Blumea 37 (1992) 179. — [*Leucostegia hirsuta* J. Sm., J. Bot. 3 (1841) 416, nom. nud.] — *Microlepia hirsuta* C. Presl, Epim. Bot. (1851) 97. — *Davallia ciliata* Hook., Sp. Fil. (1845) 184, t. 60A. — *Microlepia ciliata* (Hook.) Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 55. — Type: *Cuming 174* (iso BM, K, L), Luzon.

Davallodes grammatosorum Copel., Philipp. J. Sc., Bot. 3 (1908) 34, t. 6; Fern Fl. Philipp. (1958) 169. — *Microlepia grammatosora* (Copel.) C. Chr., Index Filic. Suppl. (1913) 50. — Type: *Copeland 1724* (iso BM, P), Mindanao.

Davallodes gymnocarpum Copel., Philipp. J. Sc., Bot. 3 (1908) 34, t. 5; Fern Fl. Philipp. (1958) 170. — *Microlepia gymnocarpa* (Copel.) C. Chr., Index Filic. Suppl. (1913) 50. — *Leucostegia gymnocarpa* (Copel.) C. Chr., Index Filic. Suppl. 3 (1934) 120. — Type: *Copeland 2075* (n.v., *Copeland 196* in K is probably part of the type), Negros.

Davallodes laxum Copel., Philipp. J. Sc. 34 (1927) 246, t. 3, f. 1; Fern Fl. Philipp. (1958) 169. — Type: *Merrill 957* (n.v.), Luzon.

Davallodes congestum Copel., Philipp. J. Sc. 34 (1927) 247, t. 3, f. 2; Fern Fl. Philipp. (1958) 169. — Type: *Copeland 1481* (iso BM, TI), Mindanao.

Davallodes dolichosorum Copel., Philipp. J. Sc. 34 (1927) 248. — Type: *Schlechter 17857* (iso K, L), Papua New Guinea.

Davallodes burbridgei C. Chr. & Holttum, Gard. Bull. Str. Settlm. 7 (1934) 230. — Type: *Burbridge s.n.* (K holo; A), Borneo, Mt Kinabalu.

Rhizome without the scales 3–7 mm diam. Scales nearly black, without pale border, distinctly acicular, lacking marginal setae or setae rare, peltate, 10–20 mm long. **Stipes** 2–20 cm long. **Lamina** compound, pinnate with strongly dissected pinnae, or bipinnate



Fig. 2. *Davallodes hirsutum* (C. Presl) Copel. (LeRoy Topping 1767).

towards the base and in the middle part, bearing multicellular hairs, 20–100 by 6–28 cm, gradually narrowed towards its base and with the lower pinnae very small, or (rarely) the lower pinnae not very small, about one third to about as long as the longest ones. Hairs between veins on each surface present (rarely absent). Longest petiolules 0–3 mm long. Longest pinnae 4–14 by 1.2–4 cm. Longest pinnules or pinna lobes 6–20 by 2–6 mm. Hairs on leaf axes 0.5–1.5 mm long. *Indusium* attached at base and only part of the sides, or also attached along the sides, pouch-shaped, or very small and inconspicuous, \pm triangular to rhomboid or oblong, longer than wide or about as wide as long (often with ciliate free upper part), 0.2–0.8 by 0.2–0.6 mm. *Indusium* lips truncate, extending to lamina margin or not, or triangular, not reaching lamina margin. — **Fig. 2.**

Distribution — *Malesia*: Sumatra (Eastcoast), Borneo (W & E Kalimantan, Sabah), Philippines (Luzon, Mindanao, Negros, Samar), Sulawesi, New Guinea (Irian Jaya: Manokwari; Papua New Guinea incl. Bismarck Arch., Bougainville, Goodenough I.).

Habitat & Ecology — Epiphytic, also in secondary and open forest. Altitude 350–1900 m.

3. *Davallodes novoguineense* (Rosenst.) Copel.

Davallodes novoguineense (Rosenst.) Copel., Univ. Calif. Publ. Bot. 12 (1931) 400; Noot., Blumea 37 (1992) 182. — *Davallia viscidula* Mett. var. *novoguineensis* Rosenst. in Fedde, Rep. 12 (1913) 526.

— Type: *Keysser 195* (BM iso), Papua New Guinea, Sattelberg.

Davallia borneensis auct. non Hook.: Rosenst. in Fedde, Rep. 10 (1912) 324.

Rhizome without the scales 5–7 mm diam. Scales light brown or nearly black, with pale border from base to apex, or this quickly diminishing or disappearing towards the apex (often at the base with a broad pale border tapering upwards), flat and nearly acicular, with marginal setae at least in the distal part, peltate, 3–8 mm long. *Stipes* 9–26 cm long. *Lamina* compound, pinnate with strongly dissected pinnae, or (usually) bipinnate towards base and in the middle part, bearing multicellular hairs, 25–55 by 9–38 cm, lower pinnae not very small, about one third to about as long as the longest. Hairs between veins on either surface present, or not. Longest petiolules 1–2.5 mm long. Longest pinnae 6–19 by 2–6 cm. Longest pinnules or pinna lobes 20–40 by 6–16 mm. Hairs on leaf axes 0.2–0.4 mm long. *Indusium* attached at the broad base and hardly or not at the sides, semicircular (sometimes ciliate), wider than long, 0.3 by 0.5–0.8 mm.

Distribution — *Malesia*: New Guinea (Irian Jaya: Lake Habbema; Papua New Guinea).

Habitat & Ecology — Terrestrial or a low epiphyte. Altitude 1500–3000 m.

Note — Some collections are intermediate with *Davallodes hirsutum*, especially in the shape of the indusium.

4. *Davallodes seramense* M. Kato

Davallodes seramense M. Kato, J. Fac. Sci. Univ. Tokyo, sect. 3, Bot. 14 (1989) 222; Noot., Blumea 37 (1992) 183. — Type: *Kato c.s. C-5624* (TI holo; BO, K, KYO, L, MO), Ceram.

Rhizome without the scales 5–15 mm diam. Scales nearly black, without pale border, distinctly acicular, lacking marginal setae or setae rare, peltate, 6–10 mm long. *Stipes*

14–25 cm long. *Lamina* compound, bipinnate towards the base and in the middle part, bearing multicellular hairs, 30–66 by 14–28 cm, the lower pinnae not very small, about one third to about as long as the longest. Hairs between veins on either surface present. Longest petiolules 1–1.5 mm long. Longest pinnae 10–17 by 2.4–3.5 cm. Longest pinnules or pinna lobes 12–20 by 3–5 mm, pinnatifid. Hairs on leaf axes 0.1–1 mm long. *Indusium* attached at the base and only along part of the sides, pouch-shaped, free for the ciliate elongate upper half, oblong, longer than wide, 1 mm by 0.3 mm; indusium lips triangular.

Distribution — *Malesia*: Moluccas (C Seram, rather common).

Habitat & Ecology — Epiphytic or epilithic in deep shade. Altitude 500–1300 m.

Note — This species is very near *Davallodes hirsutum*, it only differs from the collections with pouch-shaped indusia of the latter species in the longer free distal halves of the indusium.

5. *Davallodes urceolatum* Copel.

Davallodes urceolatum Copel., Philipp. J. Sc. 34 (1927) 248; Noot., Blumea 37 (1992) 183. — Type: Yates 526 (A iso), Sumatra.

Rhizome without the scales 4–7 mm diam. Scales nearly black without pale border, distinctly acicular, with marginal setae at least in distal part or lacking marginal setae, basifixed with cordate base and greatly overlapping basal lobes, 15 mm long. *Stipes* dark brown, 5–19 cm long. *Lamina* compound, bipinnate towards the base and in the middle part, bearing multicellular hairs, 20–80 by 8–12 cm, lower pinnae not very small, about one third to about as long as the longest. Hairs between veins on both surfaces. Longest petiolules 1 mm long. Longest pinnae 5–9 by 1.5–2.5 cm. Longest pinnules or pinna lobes 8–15 by 3–5 mm. Hairs on leaf axes 0.2–1 mm long. *Indusium* also attached along the sides, pouch-shaped, oblong, longer than wide or about as wide as long, 0.7 by 0.5–0.6 mm. Indusium lips truncate, extending as far as lamina margin or not.

Distribution — *Malesia*: Sumatra (Karo plateau near Berastagi).

6. *Davallodes viscidulum* (Mett.) Alderw.

Davallodes viscidulum (Mett.) Alderw., Bull. Jard. Bot. Buitenzorg II, 4 (1911) 6; Backer & Posth., Varenfl. Java (1939) 102; Noot., Blumea 37 (1992) 184. — *Davallia viscidula* Mett. in Kuhn, Linnaea 36 (1869) 145. — *Humata viscidula* (Mett.) Alderw., Malayan Ferns (1908) 294. — Type: Blume 1451 (L. holo), Java.

Davallia kingii Baker in Hook., Icon. Pl. (1886) t. 1622. — *Davallodes kingii* (Baker) Copel., Philipp. J. Sc., Bot. 6 (1911) 147. — Type: *Herb. Forbes, King 657* (K holo; BM, L), Java, Mt Waringin.

Rhizome without the scales 5–7 mm diam. Scales nearly black, with pale border from base to apex, or with pale border quickly diminishing or disappearing towards the apex, flat and nearly acicular, lacking marginal setae or setae rare, basifixed with cordate base and greatly overlapping basal lobes, 6–12 mm long. *Stipes* 6–22 cm long. *Lamina* compound, pinnate with strongly dissected pinnae, or (usually) bipinnate towards the base and in the middle part, bearing multicellular hairs, 26–70 by 16–45 cm; lower pinnae not very small, usually about one third to about as long as longest; hairs between veins on either surface absent or nearly so (a few scattered hairs present). Longest peti-

olules 1 mm long. Longest pinnae 8–18 by 2.5–6 cm. Longest pinnules or pinna lobes 15–32 by 3–10 mm. Hairs on leaf axes 0.2–0.5 mm long. *Indusium* scaly, attached at the narrow, cordate base only, semicircular or oblong, longer than wide, or rarely about as wide as long, 0.5–1 by 0.3–0.5 mm.

Distribution — Continental Asia: Thailand (Trang, Khao Chong); *Malesia*: Sumatra (Aceh, Westcoast, Mt Kerinci, Bengkulu), Java, Bali, SW Sulawesi.

Habitat & Ecology — Epiphytic and terrestrial, also in dry places. Altitude 100–2000 m, mostly at higher altitudes.

LEUCOSTEGIA

Leucostegia C. Presl, Tent. Pterid. (1836) 94, pl. 4, f. 11; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1955) 351; Copel., Fern Fl. Philipp. (1958) 167; Noot., Blumea 37 (1992) 184. — Type species: *Leucostegia immersa* C. Presl.

Rhizome bearing scales and hairs or only scales. Roots borne on all sides of the rhizome. Scales glabrous or bearing multiseptate hairs, basifixed, base not cordate. *Stipes* articulated at the base to phyllopodia, grooved or not, glabrous. *Lamina* compound, tripinnate or quadripinnate (rarely in small plants bipinnate) towards the base and in the middle part not dimorphous, glabrous (sometimes minute hairs present), entire to pinatilobed (often fertile leaves more strongly dissected). Pinnae deltoid or narrowly triangular. Pinnules of at least the larger pinnae anadromous. Pinnules or pinna lobes narrowly ovate. Rachis adaxially grooved. Leaf axes glabrous (sometimes a few minute hairs present). Veins in ultimate lobes simple, not reaching the margin. False veins not present. *Sori* indusiate, frequently single on a segment, terminal on the veins. *Indusium* scaly, either attached at the narrow, cordate base only, or attached at the base and only part of the sides. — **Fig. 3.**

Distribution — Continental Asia: India, Sikkim, Bhutan, Burma, N Thailand, Indochina, Cambodia, China (Yunnan), Taiwan; in *Malesia*: Malay Peninsula, Sumatra, Java, Lesser Sunda Islands, Borneo, Philippines, Sulawesi, Moluccas, New Guinea; Pacific Islands.

KEY TO THE SPECIES

- 1a. Indusium scaly, attached at the narrow, cordate base only (sometimes the base rather broad), semicircular, 1–1.5 by 1–2 mm **1. *L. immersa***
- b. Indusium attached at the base and part of the sides, oblong, 1.2–1.5 by 1 mm
..... **2. *L. pallida***

1. *Leucostegia immersa* C. Presl

Leucostegia immersa C. Presl, Tent. Pterid. (1836) 95, t. 4, f. 11; Copel., Fern Fl. Philipp. (1958) 167; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 352; Noot., Blumea 37 (1992) 185. — *Davallia immersa* Wall. [Cat. (1828) n. 256, nom. nud.] ex Hook., Sp. Fil. (1846) 156. — *Acrophorus immersus* (C. Presl) T. Moore, Proc. Linn. Soc. London 2 (1854) 286. — *Humata immersa* (C. Presl) Mett., Fil. Hort. Bot. Lips. (1856) 102; Copel., Publ. Bur. Sci. Govt. Lab. Philipp. 28 (1905) 51. — Type: Wallich 256 (K, L, P), Nepal, 1821.



Fig. 3. *Leucostegia immersa* C. Presl (Iwatsuki c. s. P 539).

Davallia immersa Hook. var. *amplissima* H. Christ, Verh. Naturf. Ges. Basel 2 (1897) 6. — Type: Sarasin 144 (n.v.), Celebes.

Humata immersa (C. Presl) Mett. var. *nana* Copel., Philipp. J. Sc. 1, Suppl. (1906) 147. — Type: Copeland 1830 (P), Luzon.

Humata dryopteridifrons Hayata, Ic. Pl. Form. 4, 6 (1916) 159. — *Davallia dryopteridifrons* Hayata, Ic. Pl. Form. 4, 6 (1916) 159, nomen. — Type: *Faurie* 615 (TI holo; L, P, TNS), Taiwan, Arisan.

Cystopteris dimidiata Decne. in Jacquem., Voy. Inde 4 (1844) 177, t. 178. — Type: *Jacquemont* s.n. (P).

Rhizome without the scales 2–15 mm diam. Scales narrowed evenly towards the apex, very hairy on the inner base at least when older. **Stipes** pale or dark brown, 8–115 cm long or more. **Lamina** tripinnate or quadripinnate (or bipinnate in small plants) towards the base and in the middle part, deltoid and broadest towards the base, glabrous (sometimes minute hairs present), 6–120 cm long or more. Longest petiolules 8–40 mm long. Ultimate leaflets rhomboid, only shallowly lobed. Ultimate segments (lobes) 0.5–3 mm long. **Indusium** scaly, attached at the narrow, cordate base only (sometimes the base rather broad), semicircular, 1–1.5 by 1–2 mm. — **Fig. 3.**

Distribution — Continental Asia: India, Sikkim, Bhutan, Burma, N Thailand, Indochina, Cambodia, China (Yunnan), Taiwan; in *Malesia*: Sumatra (Kerinci), Peninsular Malaysia (Perak), Java (1 coll. without locality), Lesser Sunda Islands (Bali, Timor), Borneo (Sabah: Mt Kinabalu; Sarawak: Baram Distr.; E Kalimantan), Philippines (Luzon, Mindanao, Mindoro, Leyte, Negros, Samar), Sulawesi, Moluccas (Seram, Ternate, Tidore), New Guinea (Irian Jaya: Idenburg River; Papua New Guinea: Morobe Prov.).

Habitat & Ecology — Epiphytic and terrestrial. Altitude 1000–2300 m, rarely lower.

2. *Leucostegia pallida* (Mett.) Copel.

Leucostegia pallida (Mett.) Copel., Philipp. J. Sc. 34 (1927) 252; Fern Fl. Philipp. (1958) 168; Holttum, Revis. Fl. Malaya, ed. 2, 2 (1966) 353; Noot., Blumea 37 (1992) 186. — *Davallia pallida* Mett. in Kuhn, Linnaea 36 (1869) 142. — Type: *Cuming* 93 (n.v.), New Hebrides.

Davallia mooreana Masters in T. Moore, Gard. Chron. (1869) 964, fig. — Type: *Hort. Veitch* 1869 (K).

Rhizome without the scales 2–15 mm diam. Scales evenly narrowed towards the apex. **Stipes** pale or dark brown, 8–115 cm long. **Lamina** tripinnate or quadripinnate (or bipinnate in small plants) towards the base and in the middle part, deltoid and broadest towards the base, glabrous (sometimes minute hairs present), 6–120 cm long or more. Longest petiolules 8–40 mm long. Ultimate leaflets rhomboid, only shallowly lobed. Ultimate segments (lobes) 0.5–3 mm long. **Indusium** attached at the base and part of the sides, oblong, 1.2–1.5 mm long, 1 mm broad.

Distribution — Continental Asia: Burma (Chin Hills); *Malesia*: Sumatra (mountains), Peninsular Malaysia (Perak: Maxwell's Hill & Larut), Borneo (Sarawak, E Kalimantan), Philippines (Luzon: Mt Bulusan), Moluccas (Seram), New Guinea (Irian Jaya, Papua New Guinea and New Ireland); Pacific: New Hebrides, Solomon Is., Bougainville, Samoa, Tahiti, Carolines, Ponape.

Habitat & Ecology — Epiphytic, epilithic, or terrestrial, sometimes in riverbed. On various kinds of substrate, also on limestone. Altitude 0–2100 m.

Note — The rhizome is glabrous according to Kato [J. Fac. Sc. Univ. Tokyo III, 13 (1985) 553–573]. However, in some plants I observed hairs on the rhizome, the scales themselves being glabrous.

AZOLLACEAE

(R.M.K. Saunders, Hong Kong)

Azollaceae Wettst., Handb. Syst. Bot. 2 (1903) 77; C. Chr. in Verdoorn, Man. Pterid. (1938) 550; Wettst., Trat. Bot. Sist. (1944) 416; Reed, Bol. Soc. Brot. II, 28 (1954) 15.

Small aquatic plants with flabellate branched stems bearing roots and leaves. *Leaves* sessile, alternate, imbricate, bilobed. *Dorsal leaf lobe* fleshy and chlorophyllous, held above water surface; with uni- or bicellular trichomes, and anomocytic stomata; with cavity containing mucilage and filaments of the cyanobacterium *Anabaena azollae*. *Ventral leaf lobe* generally unistratose and translucent (except at base), resting on water surface. *Roots* either solitary or in fascicles, growing from stem branching points; with numerous root hairs and two semi-persistent root caps and a basal root sheath. *Sporocarps* borne in pairs or fours at base of branches, initially covered by involucre of dorsal leaf lobe. Plants monoecious, with separate mega- and microsporocarps. *Megasporocarp* containing a solitary indehiscent megasporangium, which contains a single megaspore attached by placenta. Megaspore with trilete mark, and 3 or 9 proximally positioned alveolate 'floats' (up to 24 in fossil taxa) attached by filusum of megasporoderm. Megasporoderm sculpturing and stratification variable and often highly complex. Megagametophyte endosporic, forcing megaspore open at laesura, bearing several archegonia. *Microsporocarp* containing numerous indehiscent microsporangia that develop successively from apex to base; each microsporangium with c. 64 trilete microspores. Microspores aggregated together in alveolate structures ('massulae'), analogous to floats. *Massulae* partially or fully covered with simple or glochidiate trichomes. Microspores germinating within massula; microgametophyte reduced, with one antheridium; antherozoids multiflagellate, released through flask-shaped cavities in massula.

One genus only.

AZOLLA

Azolla Lam., Encycl. Méth. Bot. 1 (1) (1783) 343; Mett. in Kotschy & Peyritsch, Pl. Tinn. (1867) 51–52; Strasb., Über Azolla (1873) 76–77; Baker, J. Bot. 25 (1886) 99–100, reprinted in Handb. Fern Allies (1887) 137; Reed, Bol. Soc. Brot. II, 28 (1954) 15–16; Schneller in Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 57; Saunders & Fowler, Pl. Syst. Evol. 184 (1993) 175–193. — Type species: *Azolla filiculoides* Lam.

Characters of the family. — **Fig. 1.**

Distribution — Almost cosmopolitan, throughout wet tropics and warm temperate regions (about 6 or 7 species); throughout *Malesia* (1 species).

Habitat — Free-floating aquatics on stagnant or slow-flowing freshwater sites, or else rooted on wet mud that is not subject to drying.

Ecology — *Azolla* maintains a symbiotic association with the cyanobacterium (blue-green alga) *Anabaena azollae* Strasb., which is able to fix atmospheric nitrogen; this allows the association to grow in nitrate-poor environments that cannot easily be colonised by other hydrophytes (Moore 1969; Lumpkin & Plucknett 1980, 1982; Shi & Hall 1988).

Reproduction in *Azolla* is often vegetative, by fragmentation of the stem; this enables rapid population growth under favourable environmental conditions, and consequently *Azolla* can often become an aggressive weed, clogging waterways and drainage systems. *Azolla* also possesses an advanced heterosporous life cycle, however, with distinct micro- and megaspores. The gametophytes are endosporic (retained within the spore), and are consequently protected from desiccation of the environment. If the megagametophyte has been fertilised, it can therefore survive periods of seasonal drying and allow continuity of the population.

Literature: Lumpkin, T.A. & D.L. Plucknett, *Econ. Bot.* 34 (1980) 111–153; *Azolla* as green manure (1982); Moore, A.W., *Bot. Rev.* 35 (1969) 17–34; Shi, D.-J. & D.O. Hall, *Bot. Rev.* 54 (1988) 353–386.

Fossils — There is an extensive fossil history of *Azolla*, with the earliest record that of *A. simplex* Hall from the late Cretaceous of North America (Hall 1969a). The soft herbaceous structure of the sporophytic tissues has generally precluded fossilisation, and most records are of isolated massulae or megaspores. Significant exceptions to this, however, are *A. schopfii* Dijkstra from the Cretaceous to Palaeocene of North America (Sweet & Chandrasekharam 1973), and *A. stanleyi* Jain & Hall, from the Paleocene of North America (Rothwell & Stockey 1994), for which vegetative remains have been described in detail.

Five exclusively fossil sections have been described, viz. Sect. *Antiqua* P.I. Dorof. (1959), Sect. *Filifera* J.W. Hall (1968), Sect. *Krematospora* R.K. Jain & J.W. Hall (1969), Sect. *Simplicispora* J.W. Hall (1970) and Sect. *Trisepta* K. Fowler (1975). Important reviews of extinct *Azolla* species can be found in J.W. Hall (1969b, 1974); R.K. Jain & J.W. Hall (1969), R.K. Jain (1971), M.E. Collinson (1980) and R.M.K. Saunders & K. Fowler (1993).

Several fossil genera have also been described which are believed to be closely related to or ancestral to *Azolla*, viz. *Glomerisporites* Pot. (J.W. Hall 1974, 1975), *Azolopsis* J.W. Hall (J.W. Hall 1968, 1974; Sweet & Hills 1974), *Parazolla* J.W. Hall (J.W. Hall 1969a, 1974; Collinson 1991), and *Hydropteris* Rothwell & Stockey (1994).

References: Collinson, M.E., *Palaeontology* 23 (1980) 213–229; in S. Blackmore & S.H. Barnes (eds.), *Pollen and Spores: Patterns of diversification* (1991) 119–150. — Dorofeev, P.I., *Bot. Zh. SSSR* 44 (1959) 1756–1763. — Fowler, K., *Palaeontology* 18 (1975) 483–507. — Hall, J.W., *Amer. Fern J.* 58 (1968) 77–88; *Amer. J. Bot.* 56 (1969a) 1173–1180; *J. Palaeont.* 43 (1969b) 528–531; *Taxon* 19 (1970) 302–303; *Ann. Missouri Bot. Gard.* 61 (1974) 354–367; *Amer. J. Bot.* 62 (1975) 359–369. — Jain, R.K., *Amer. J. Bot.* 58 (1971) 487–496. — Jain, R.K. & J.W. Hall, *Amer. J. Bot.* 56 (1969) 527–539. — Rothwell, G.W. & R.A. Stockey, *Amer. J. Bot.* 81 (1994) 479–492. — Saunders, R.M.K. & K. Fowler, *Pl. Syst. Evol.* 184 (1993) 175–193. — Sweet, A.R. & A. Chandrasekharam, *Can. J. Bot.* 51 (1973) 1491–1496. — Sweet, A.R. & L.V. Hills, *Can. J. Bot.* 52 (1974) 1625–1642.

Phylogeny — Cladistic analysis has elucidated several different phylogenetic trends in the genus [R.M.K. Saunders & K. Fowler, *Pl. Syst. Evol.* 184 (1993) 175–193]. There appears to have been a reduction of somatic structures in response to the aquatic habit, including overall plant size, adaptations to enhance buoyancy, and the simplification of leaf and stem vascular anatomy. There also appears to have been increased specialisation of both micro- and megasporocarpic reproductive structures, including a reduc-

tion in the number of floats per megaspore apparatus, an increase in the complexity of float arrangement and attachment, and a reduction in the size of the microspores.

Vegetative structure — Evolutionary adaptations favouring a free-floating aquatic habit have resulted in a highly reduced vegetative morphology, reviewed by Saunders & Fowler (1993). The diminutive sporophyte consists of a branched stem that floats horizontally on the water surface and bears alternately arranged imbricate bilobed leaves and pendulous roots (Fig. 1a, b). The absence of xeric stresses has resulted in the reduction of the stem vascular system to a haplostelic protostele in most species, and the leaves are almost devoid of a vascular trace.

Contrary to many descriptions, the ventral lobes rest on the water surface, and are not submerged (Svenson 1944). The pockets of air trapped between the two leaf lobes, together with the forces of surface tension acting between the ventral lobe and the water, enable the plants to remain buoyant. Buoyancy is also maintained by numerous hydrophobic papillae (trichomes) on the upper surface of the dorsal leaf lobes. These trichomes have been shown to be diagnostically important (Dunham & Fowler 1987), being composed of either a single erect cell which is basally contiguous with the epidermal layer, or of two cells, with one cell superficially positioned on an epidermal cell.

The cyanobacterium *Anabaena azollae* is maintained in a cavity of the dorsal leaf lobe; a specialised 'cavity trichome' has been shown to be involved in metabolite exchange between the fern and its endosymbiont (Calvert et al. 1985a). As new leaves develop at the meristem, the cavity needs to be inoculated with *Anabaena* cells. This is achieved by means of the 'apical trichome', which becomes entwined with strands of *Anabaena*; as leaf development progresses, the apical trichome becomes incorporated within a depression which represents the initial stage in leaf cavity formation (Calvert & Peters 1981; Peters & Calvert 1983; Calvert et al. 1985b).

The occurrence of *Anabaena* in the dorsal leaf lobes of *Azolla* is very widespread, although the association is not obligate since rare naturally occurring *Anabaena*-free populations have been reported (Huneke 1933; Shen 1960). Bacteria belonging to the genus *Arthrobacter* have recently been recognized as a possible third partner in the symbiosis (Wallace & Gates 1986; Petro & Gates 1987; Carrapico 1991).

Rapid vegetative reproduction is achieved through fragmentation of the stem by abscission of branches. Uheda et al. (1995) have shown that this is achieved by the degradation of the middle lamella between the cells in mature regions of the stem.

References: Calvert, H.E., M.K. Pence & G.A. Peters, *Protoplasma* 129 (1985a) 10–27. — Calvert, H.E., S.K. Perkins & G.A. Peters, *Amer. J. Bot.* 72 (1985b) 808. — Calvert, H.E. & G.A. Peters, *New Phytol.* 89 (1981) 327–335. — Carrapico, F., *Pl. Soil* 137 (1991) 157–160. — Dunham, D.G. & K. Fowler in: *Intern. Rice Res. Inst., Azolla Utilization* (1987) 7–16. — Huneke, A., *Beitr. Biol. Pflanz.* 20 (1933) 315–341. — Peters, G.A. & H.E. Calvert in: L.J. Goff, *Algal Symbiosis: A continuum of interaction strategies* (1983) 109–145. — Petro, M.J. & J.E. Gates, *Symbiosis* 3 (1987) 41–48. — Saunders, R.M.K. & K. Fowler, *Pl. Syst. Evol.* 184 (1993) 175–193. — Shen, E.Y.-F., *Taiwania* 7 (1960) 1–7. — Svenson, H.K., *Amer. Fern J.* 34 (1944) 69–84. — Uheda, E., et al., *Int. J. Pl. Sci.* 156 (1995) 756–763. — Wallace, W.H. & J.E. Gates, *Appl. Environ. Microbiol.* 52 (1986) 425–429.

Reproductive structure and life cycle — *Azolla* is heterosporous and monoecious, with separate leptosporangiate micro- and megasporangia, which are borne in enclosed indusial micro- and megasporocarps. The megasporocarp contains a single megasporangium, which contains a single megaspore; the microsporocarp, however, contains numerous microsporangia, each of which contains many aggregates of microspores.

Sexual reproduction in *Azolla* involves the rupturing of the sporocarps to liberate the sporangia, which subsequently sediment out. The microsporangia subsequently rupture, although the microspores are not released into the water directly, but are aggregated together into complex structures known as 'massulae' (Fig. 1c), which consist of hardened mucilage. Each massula bears trichomes which enable attachment to the megaspore prior to antherozoid release; the massula trichomes are either spiniform or barbed ('glochidiate'). The antherozoids are multiflagellate (Dunham & Fowler 1987) and are released from the antheridia in situ within the massula by means of specialized flask-shaped cavities (Fowler 1975).

The megaspore (Fig. 1d) has a highly sculptured sporoderm, and has a 'filosum' of fine perinous hairs. The filosum on the distal surface of the megaspore and collar region is known as the 'infrafilosum' and is an adaptation to enhance the likelihood of massula attachment; this is absent from some species, however. The filosum on the proximal megaspore surface, the 'suprafilosum', is involved in the attachment of the 'floats' (Fig. 1d). The floats are analogous to the massulae, and contain seven aborted megaspores; there are three or nine floats in extant species, although extinct species often have more. The megaspore and the proximally positioned float structures are collectively referred to as the 'megaspore apparatus'.

Antherozoid release from the antheridia in the male gametophyte results in the fertilisation of the oospore in the archegonium (in situ within the female gametophyte). The developing sporophyte emerges from the proximal pole of the megaspore apparatus, and ruptures the megasporangial wall before pushing aside the remains of the sporocarp wall (indusial cap).

Strands of *Anabaena* are located between the megasporocarp and megasporangial walls, allowing maintenance of the symbiotic association (Perkins & Peters 1993). As the funnel-shaped first leaf emerges, it dislodges the *Anabaena* and establishes a colony around an apical trichome that is incorporated into the dorsal leaf cavity (Becking 1987; Dunham & Fowler 1987; Peters & Perkins 1993).

References: Becking, J.H., Pl. Soil 100 (1987) 183–212; Dunham, D.G. & K. Fowler, Bot. J. Linn. Soc. 95 (1987) 43–53. — Fowler, K., Amer. Fern J. 65 (1975) 7–10. — Perkins, S.K. & G.A. Peters, New Phytol. 123 (1993) 53–64. — Peters, G.A. & S.K. Perkins, New Phytol. 123 (1993) 65–75.

Chromosomes — The chromosomes of *Azolla* are the smallest recorded for pteridophytes (Loyal 1975), and this has often resulted in the publication of inaccurate chromosome counts, reviewed in Stergianou & Fowler (1990). All *Azolla* species have a diploid chromosome number of 44, except *A. nilotica* Decne. ex Mett. which is $2n = 52$ (Stergianou & Fowler 1989, 1990). Triploids ($2n = 66$) have been discovered in four species (Stergianou & K. Fowler, l.c.), and one tetraploid ($2n = 88$) population has also been reported (Stergianou & Fowler, l.c.; Saunders & Fowler 1993).

References: Loyal, D.S. in P. Kachroo, *Advancing Frontiers in Cytogenetics* (1975) 293–298. — Saunders, R.M.K. & K. Fowler, *Pl. Syst. Evol.* 184 (1993) 175–193. — Stergianou, K.K. & K. Fowler, *Brit. Fern Gaz.* 13 (1989) 317–319; *Pl. Syst. Evol.* 173 (1990) 223–239.

Phytochemistry and chemotaxonomy — A limited amount of research has been conducted using anthocyanins (Shimura & Terada 1967; Holst 1977; Ishikura 1982) although this was not considered in a taxonomic context, and only involved the identification of the compounds occurring. Related studies of the phenolic compounds in *Azolla*, including flavonoids, have been interpreted taxonomically (Van Hove et al. 1987). The chemical composition of the spore apparatus has also been studied (Toia et al. 1985; Van Bergen et al. 1993).

The phytochemical research that has proved most valuable for deducing taxonomic and phylogenetic relationships in *Azolla* has involved studies of isozyme variation (Zimmermann et al. 1989a, b, 1991a, 1994) and molecular data (Zimmerman et al. 1991b, 1993, 1994; Eskew et al. 1993; Van Coppenolle et al. 1993). Restriction fragment length polymorphism (RFLP) studies of the endosymbiont clearly indicate co-evolution with the *Azolla* host (Van Coppenolle et al. 1995).

References: Eskew, D.L., et al., *Pl. Mol. Biol.* 21 (1993) 363–373. — Holst, R.W., *Amer. Fern J.* 67 (1977) 99–100. — Ishikura, N., *Bot. Mag. (Tokyo)* 95 (1982) 303–308. — Shimura, Y. & S. Terada, *J. Jap. Bot.* 42 (1967) 266–271. — Toia, R.E., et al., *Amer. Fern J.* 75 (1985) 38–43. — Van Bergen, P.F., et al., *Grana, Suppl.* 1 (1993) 18–30. — Van Coppenolle, B., et al., *Genome* 36 (1993) 686–693; *Theor. Appl. Genet.* 91 (1995) 589–597. — Van Hove, C., et al., *Intern. Rice Res. Inst., Azolla Utilization* (1987) 77–87. — Zimmerman, W.J., et al., *Euphytica* 42 (1989a) 163–170; *Euphytica* 43 (1989b) 223–232; *Pl. Soil* 137 (1991a) 161–170; *New Phytol.* 119 (1991b) 561–566; *Amer. Fern J.* 83 (1993) 97–104; *Amer. Fern J.* 84 (1994) 86–93.

Uses — As a result of the nitrogen fixing capability of the *Anabaena* endosymbiont, *Azolla* is useful as an organic fertilizer in tropical lowland rice cultivation and has been used in Chinese and Vietnamese agriculture for over two thousand years (Moore 1969; Lumpkin & Plucknett 1980, 1982). Research and effective management practices have increased the potential for higher rice yields when grown with *Azolla*. The average nitrogen fixing activity of *Azolla* is 1–2 kg N ha⁻¹ day⁻¹ (Watanabe 1982); this is sufficient to meet the nitrogen requirement of rice if the *Azolla* is grown for the period of one rice cropping. Liu (1979) has estimated that the effective use of *Azolla* in paddy fields can increase rice yields by an average 600–700 kg ha⁻¹. Within Malesia, the use of *Azolla* in rice cultivation has mainly been restricted to the Philippines (Mabbayad 1987) where considerable agronomic research on *Azolla* has been conducted at the International Rice Research Institute (IRRI) at Los Baños. Recent attempts at hybridizing *Azolla* species (Do et al. 1989; Watanabe et al. 1993) have revealed positive heterosis in growth and nitrogen fixation abilities.

Azolla has also been grown with water bamboo (*Zizania aquatica* L.), arrow head (*Sagittaria sagittifolia* L.) and taro [*Colocasia esculenta* (L.) Schott], and has been used in aquatic weed control and as a fodder for pigs, cattle, poultry and fish (Lumpkin & Plucknett 1982). *Azolla* is also proving to be an important antipollutant: its ability to extract phosphorus from eutrophic water, even after complete denitrification, has resulted in many investigations assessing its use as a decontaminant in sewage treatment

(Shiomi & Kitoh 1987; De Wet et al. 1990). The formation of dense mats of *Azolla* on the surface of stagnant bodies of water has also led to an evaluation of its efficacy in mosquito control (Ansari & Sharma 1991; Rajendran & Reuben 1991).

References: Ansari, M.A. & V.P. Sharma, *Ind. J. Malariology* 28 (1991) 51–54. — De Wet, L.P.D., et al., *Water S.A. (Pretoria)* 16 (1990) 281–286. — Do, V.C., et al., *Can. J. Bot.* 67 (1989) 3482–3485. — Liu, C.C., in *Intern. Rice Res. Inst., Nitrogen and Rice* (1979) 375–394. — Lumpkin, T.A. & D.L. Plucknett, *Econ. Bot.* 34 (1980) 111–153; *Azolla* as green manure (1982). — Mabbayad, B.B., in *Intern. Rice Res. Inst., Azolla Utilization* (1987) 101–108. — Moore, A.W., *Bot. Rev.* 35 (1969) 17–34. — Rajendran, R. & R. Reuben, *Med. Vet. Entomol.* 5 (1991) 299–310. — Shiomi, N. & S. Kitoh, in *Intern. Rice Res. Inst., Azolla Utilization* (1987) 169–176. — Watanabe, I., in Y.R. Dommergues & H.G. Diem, *Microbiology of Tropical Soils and Plant Productivity* (1982) 169–185. — Watanabe, I., et al., *Soil Sci. Pl. Nutr.* 39 (1993) 669–676.

Taxonomy — Extant species of *Azolla* have historically been classified into two sections, *Azolla* (4 or 5 species) and *Rhizosperma* (Mey.) Mett. (2 species) (Mettenius 1847), although these taxa have also been regarded as subgenera (Strasburger, 1873). A phylogenetically more acceptable supraspecific classification of the genus has recently been proposed by Saunders & Fowler (1993), however, as follows.:

Subgenus *Azolla*

sect. *Azolla* (4 or 5 species)

sect. *Rhizosperma* (1 species, also in Malaysia)

Subgenus *Tetrasporocarpia* Saunders et Fowler (1 species).

References: Mettenius, G.H., *Linnaea* 20 (1847) 259–282. — Saunders, R.M.K. & K. Fowler, *Pl. Syst. Evol.* 184 (1993) 175–193. — Strasburger, E., *Über Azolla* (1873).

Azolla pinnata R. Br.

Azolla pinnata R. Br., *Prodr. Fl. Nov. Holl.* (1810) 167; Mett., *Linnaea* 20 (1847) 273; Strasb., *Über Azolla* (1873) 79; Baker, *J. Bot.* 25 (1886) 100, repr. in *Handb. Fern Allies* (1887) 138; Sweet & Hills, *Amer. Fern J.* 71 (1971) 3; Fowler & Stennett-Willson, *Brit. Fern Gaz.* 11 (1978) 409; Zhou, *Rev. Palaeobot. Palyn.* 39 (1983) 111; Ashton & Walmsley, *Bot. J. Linn. Soc.* 89 (1984) 242; Saunders & Fowler, *Bot. J. Linn. Soc.* 109 (1992) 348. — Types: *R. Brown 134*, Oct. 1804 (BM lecto; E, K), Richmond, Hawkesbury, Australia; *R. Brown 135*, Oct. 1804 (BM, E, K, para), Paterson's River, Australia.

Salvinia imbricata Roxb. ex Griff., *Calc. J. Nat. Hist.* 4 (1844) 470. — *Azolla pinnata* R. Br. var. *imbricata* (Roxb. ex Griff.) Bonap., *Notes Ptérid.* 7 (1918) 130. — *Azolla imbricata* (Roxb. ex Griff.)

Nakai, *Bot. Mag. (Tokyo)* 39 (1925) 185. — Type: *Roxburgh s.n.* (BR lecto; BM, G), Bengal, India. *Azolla decomposita* Zoll., *Syst. Verz.* (1854) 51, nom. nud., based on *Zollinger 408* from Java (P).

Plants triangular to trapezoidal; branching alternate, with basal branches sometimes similarly branched. *Main stem* with protostelic vascular system. Devoid of leaves except for those that subtend branches; trichomes present, although often sparse and aggregated near base of leaf lobes. *Dorsal leaf lobes* with variable degree of imbrication; hyaline margins generally of (2–)3(–4) cells diameter. Leaf trichomes consisting of a cell superficially positioned on an 'epidermal' cell. Red anthocyanin pigments evident under adverse environmental conditions. *Ventral leaf lobes* devoid of stomata and trichomes. *Roots* solitary, with obliquely arranged groups of (3–)5–6 root hairs; (9–)12

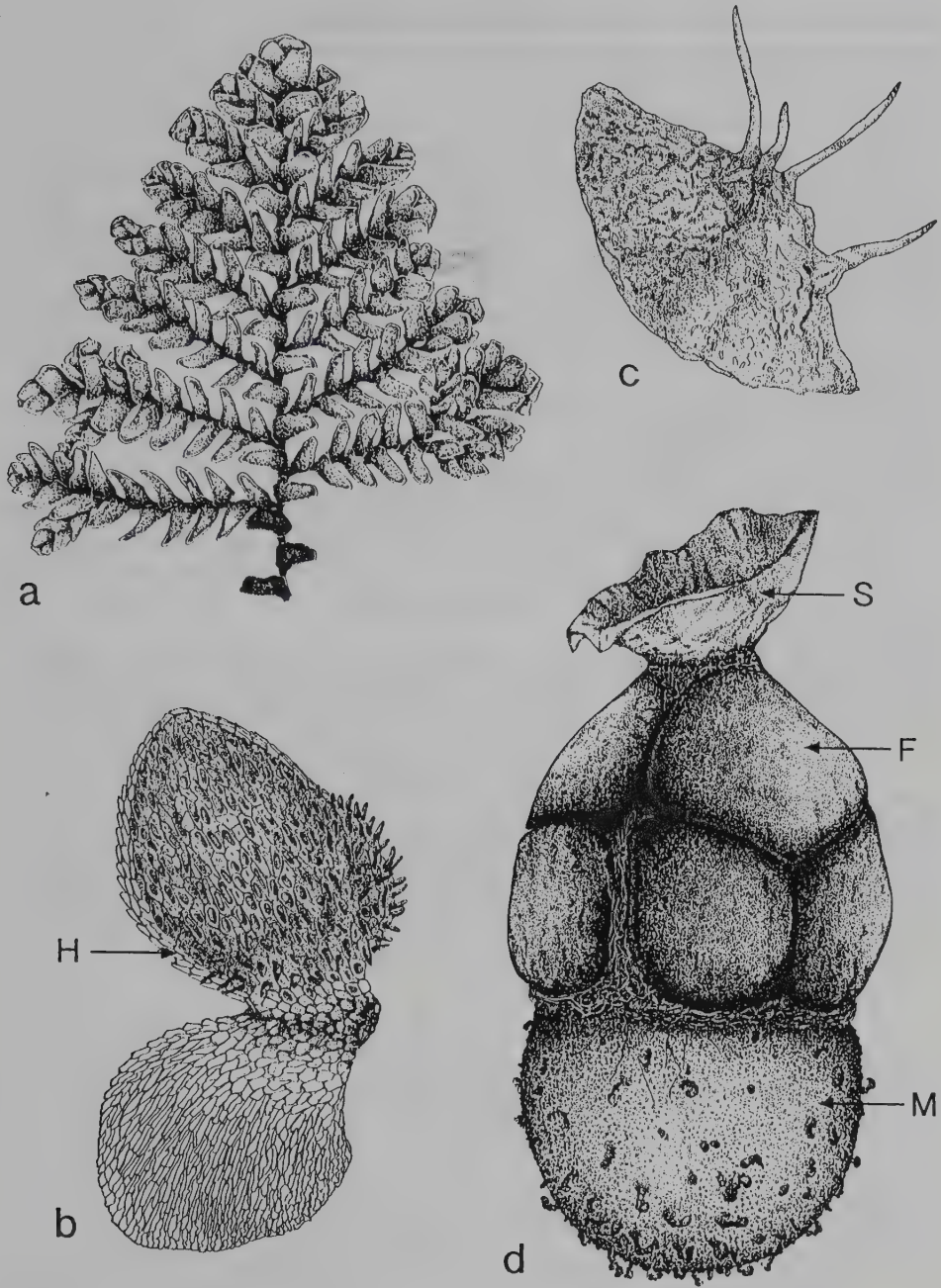


Fig. 1. *Azolla pinnata* R. Br. a. Entire plant (viewed from above), $\times 7$; b. leaf with dorsal and ventral lobes, with hyaline margin (H), $\times 30$; c. massula with simple trichomes, $\times 450$; d. megaspore apparatus, with suprafilosum (S) retaining floats (F) in position over proximal pole of megaspore (M), $\times 100$. Del. S.J. Stanley.

outer cortical cells and (13–)18(–19) epidermal cells in transverse section. *Megaspore* sporoderm surface of anastomosing baculae, often fused to form a surface of rounded nodules; baculae aggregated into prostrate or erect elongate or tuberculate excrescences, especially pronounced near distal pole. Excrescences of anastomosing baculae with interstices, or with smooth surface. Collar of megaspore apparatus comparatively small, without flange; both internal and external surfaces covered with filiform. *Massulae* with simple spiniform trichomes without glochidiate apex; 2–4(–12) trichomes on inner surface only, aseptate with occasional irregular internal cavities, sometimes with small irregular protuberances. — **Fig. 1.**

Distribution — Wet tropical Africa, Madagascar, India, Sri Lanka, southern and eastern China, SE Asia, northern and eastern Australia, and New Caledonia; in *Malesia*: throughout.

Infraspecific taxa — In a recent revision of the taxonomy of *Azolla pinnata* [R.M.K. Saunders & K. Fowler, Bot. J. Linn. Soc. 109 (1992) 329–357] three subspecies were accepted, of which only one is indigenous to Malesia: *A. pinnata* R. Br. subsp. *asiatica* Saunders et Fowler, Bot. J. Linn. Soc. 109 (1992) 349 [Type: *T. Sørensen*, *K. Larsen* & *B. Hansen* 1829, 2 March 1958, N Phayao, Thailand (K holotype)]. This subspecies possesses lax to slightly imbricate dorsal leaf lobes with narrow hyaline margins (width of leaf/width of margin = c. 9.5/1), and a megasporoderm surface of prostrate or erect elongate excrescences.

Chromosomes — The chromosome number has been reported to be $n = 22$ [D.S. Loyal, Curr. Sci. 27 (1958) 357–358] or $2n = 44$ [D.S. Loyal in P. Kachroo, Advancing Frontiers in Cytogenetics (1975) 293–298; D.S. Loyal et al., Br. Fern Gaz. 12 (1982) 230–232; P.K. Singh et al. in W.S. Silver & E.C. Schröder, Practical Applications of *Azolla* for Rice Production (1984) 55–65; S.K. Nayak & P.K. Singh, Cytologia 54 (1989) 275–286; K.K. Stergianou & K. Fowler, Brit. Fern Gaz. 13 (1989) 317–319; Pl. Syst. Evol. 173 (1990) 223–239; R.M.K. Saunders & K. Fowler, Pl. Syst. Evol. 184 (1993) 175–193]. Triploidy ($2n = 66$) and tetraploidy ($2n = 88$) are also reported (K.K. Stergianou & K. Fowler, l.c.; R.M.K. Saunders & K. Fowler, l.c.).

CHEIROPLEURIACEAE

(J. E. Laferrière, Providence, USA)

Cheiropleuriaceae T. Nakai, Bot. Mag. (Tokyo) 42 (1928) 210.

Terrestrial or epilithic herb. *Rhizome* woody, creeping or subscandent, protostelic, lacking scales, covered with soft, uniseriate, pale brown, multicellular hairs. *Fronds* dimorphous. *Petioles* glabrous except at base, not articulated to rhizome. *Sterile fronds* often simple but typically 2(–4)-lobed, entire and lobed blades often appearing on the same plant, lamina glabrous, coriaceous; the lobes (if present) acuminate with a broad sinus between; base broadly rounded or sometimes obtuse or acute; margins entire, sometimes slightly revolute; main veins dichotomous, smaller veins reticulate. *Fertile fronds* simple, narrow, linear to narrowly lanceolate, gradually tapering at both ends; upper surface glabrous; lower surface wholly covered with sporangia and simple club-shaped paraphyses except along the 1–3 main veins and a narrow strip along the margin. *Sporangia* long-stalked, annulus almost vertical, extending most of the way round the sporangium. *Spores* creamy-white to pale brown.

One genus with one species.

TAXONOMY

The family has often been treated as part of the *Polypodiaceae*. The unique sporangial structure, however, suggests a more distant relationship. See K. A. Wilson, Contr. Gray Herb. 185 (1959) 97–127.

CHEIROPLEURIA

Cheiropleuria C. Presl, Epim. Bot. (1851) 189; Holttum, Revis. Fl. Malaya 2 (1954) 136; Ohwi, Fl. Japan (1965) 97; DeVol in Fl. Taiwan 1 (1975) 163; Walker, Fl. Okinawa (1976) 111; Tagawa & Iwatsuki in Fl. Thailand 3 (1979) 484; Kramer in Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 69. — Type species: *Cheiropleuria bicuspis* (Blume) C. Presl.

Characters of the family. One species.

Cheiropleuria bicuspis (Blume) C. Presl

Cheiropleuria bicuspis (Blume) C. Presl, Epim. Bot. (1851) 189; Holttum, Rev. Fl. Malaya 2 (1954) 136. — *Polypodium bicuspe* Blume, Enum. Pl. Jav. (1828) 125. — Type: *Blume s.n.* (L, sh. 908.328–51). *Cheiropleuria bicuspis* (Blume) C. Presl var. *integrifolia* Alderw., Malayan Ferns (1908) 733. — Type: not indicated.

Rhizome 4–10 mm in diam.; hairs up to 1 cm long. *Fronds* extremely variable in proportions. *Sterile fronds* 20–60 cm long, lamina up to 21 by 16(–30) cm. *Fertile fronds* usually longer than sterile ones, up to 52 cm long, lamina (5–)10–12(–25) mm wide. *Petioles* 20–50 cm long. — **Fig. 1.**

Distribution — Throughout *Malesia* to southern Japan, southern China, Vietnam and Thailand.

Habitat — Usually on steep or rocky, generally rather dry soil in hills and mountains. Altitude 600–1500 m.

Taxonomy — The leaves of this species are highly variable, with entire and lobed leaves sometimes appearing on the same plant. For this reason, var. *integrifolia* is not recognized here as a separate taxon.

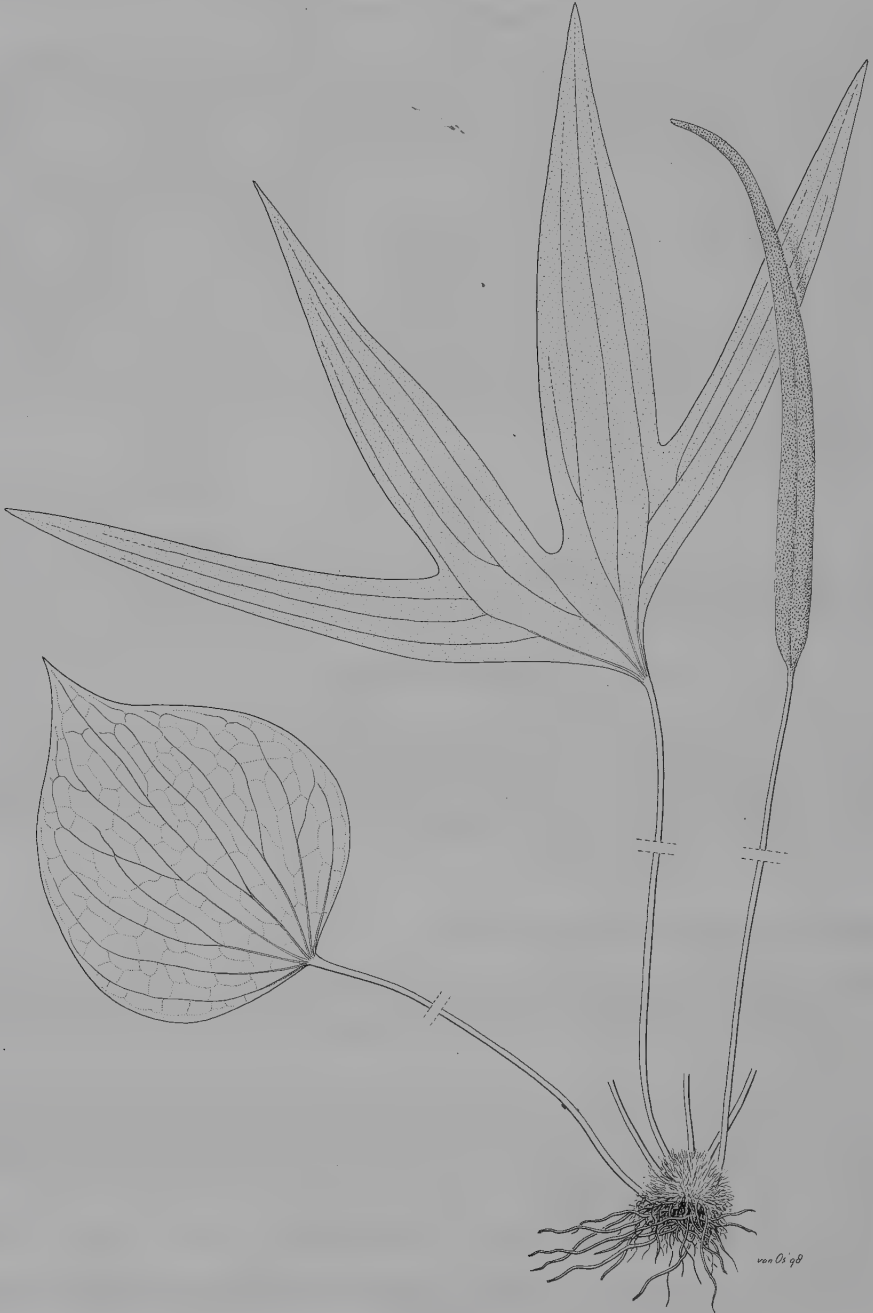


Fig. 1. *Cheiropleuria biscuspidata* (Blume) C. Presl. Habit with sterile and fertile leaves; $\times 0.5$.

EQUISETACEAE

(J.E. Laferrière, Providence, USA)

Equisetaceae A.P. DC. in Lam. & DC., Fl. Franç., ed. 3, 2 (1805) 580.

Terrestrial *herbs*, usually of wet places, sometimes as agricultural weeds. *Stems* elongate, articulate, usually hollow, originating from a subterranean rhizome, monomorphic or dimorphic; branches absent, solitary, opposite or in whorls, ribbed or striate, usually with hollow internodes, originating from base of foliar sheath. *Leaves* small, whorled, laterally connected into a toothed, tubular to funnel-form sheath. *Sporangiophores* peltate, scale-like, forming terminal strobili, these borne on vegetative stems or on achlorophyllous fertile stems (not in Malesia), each sporangiophore bearing 6–9 sporangia in a single row along the underside of the margin. *Spores* homosporous, globose, bearing 4 long, filiform, cruciately arranged, apically clavate hygroscopic appendages (elaters).

One genus with 15 species. Relict group with long fossil history. Cosmopolitan except Australia, New Zealand, and Antarctica.

EQUISETUM

Equisetum L., Sp. Pl. (1753) 1061; Gen. Pl., ed. 5 (1754) 484; Hauke in Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 46. — Type species: *Equisetum arvense* L.

Hippochaete Milde, Bot. Zeit. 23 (1865) 297. — Type species: *Hippochaete hyemalis* (L.) Börner [= *Equisetum hyemale* L.].

Characters of the family. One subspecies in *Malesia*.

***Equisetum ramosissimum* Desf. subsp. *debile* (Vauch.) Hauke**

Equisetum ramosissimum Desf. subsp. *debile* (Roxb. ex Vauch.) Hauke, Am. Fern J. 52 (1962) 33; DeVol in Fl. Taiwan 1 (1975) 56. — *Equisetum debile* Roxb. ex Vauch., Mém. Soc. Phys. Hist. Nat. Genève (Mon. Prêles) 1 (1822) 387; Tagawa & K. Iwats. in Fl. Thailand 3 (1979) 34. — *Hippochaete debilis* (Roxb. ex Vauch.) Holub, Preslia 44 (1972) 128. — Type: *Roxburgh s.n.* (n.v.).

Rhizomes subterranean, somewhat rough, dark brown to black, 6–8-sectored, vascular bundles each surrounded by an endodermis. *Stems* monomorphic, smooth, irregularly branched, evergreen, solitary to caespitose, 45–300(–900) cm tall, 2–5 mm in diam., with 10–32 ridges; branches solitary or in groups of 2–3(–5), up to 60 cm long, straight or sinuous, simple or occasionally secondarily branched. *Sheaths* green, cylindrical to slightly funnel-shaped, 4.5–13 mm long, 2–12 mm wide; segments smooth, the midrib prominently vaulted and ridged basally, sometimes becoming flattened apically, with two distinct lateral ridges; teeth with central brown band and broad, white or colourless margins, often deciduous. *Branches* 6–10-angled, with sheaths like those of the stem, or with persistent teeth. *Strobilus* yellow to black, nearly obtuse to apiculate, up to 25 mm long, 7 mm wide, with the apiculum up to 1 mm long. — **Fig. 1.**

Chromosome number: $n = 108$ [Ninan, J. Ind. Bot. Soc. 34 (1955) 112–114].

Distribution — India and southern China, throughout *Malesia* to New Caledonia and Fiji. Subsp. *ramosissimum* is known from southern and eastern Africa, southern and central Europe, and most of Asia except Malesia.

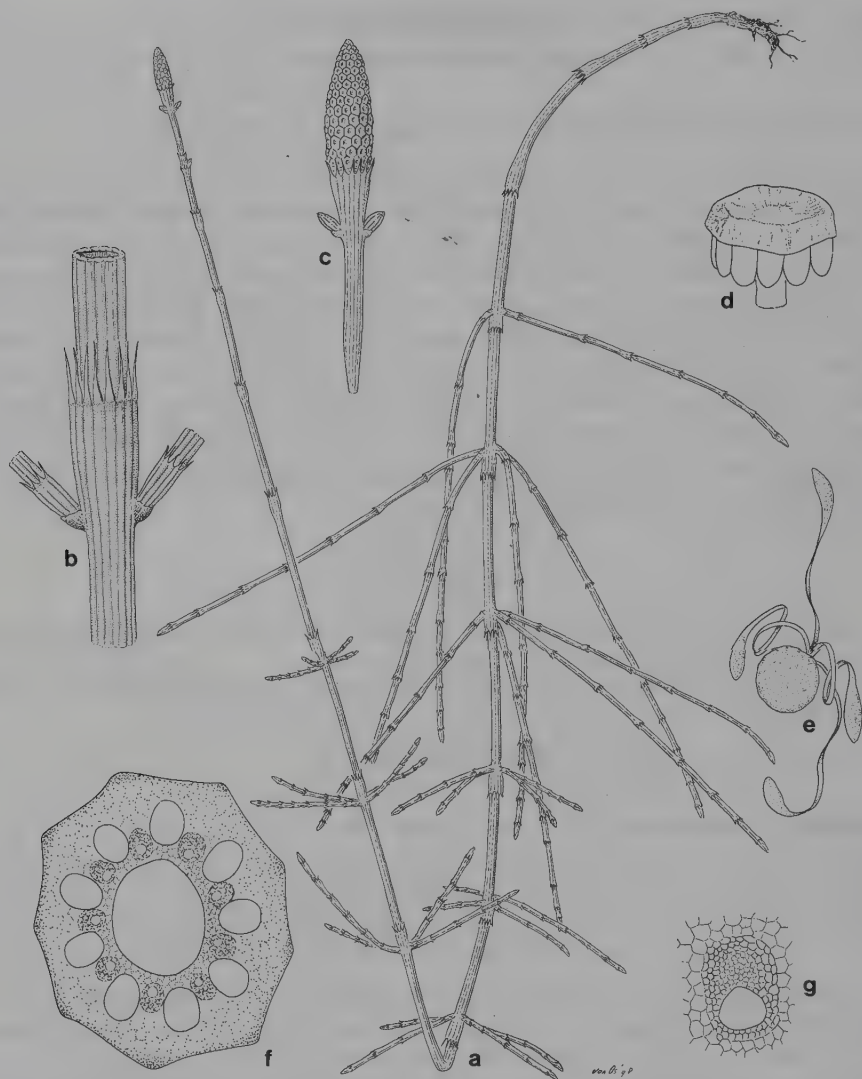


Fig. 1. *Equisetum ramosissimum* Desf. subsp. *debile* (Vauch.) Hauke. a. Habit, $\times 0.5$; b. aerial stem; c. strobilus; d. sporangiophore; e. spore. f. cross section of internode; g. endodermis surrounding vascular bundle and carinal canal.

Habitat — Wet places, riverbanks, and open sites, to over 3500 m altitude.

Taxonomy — This taxon is here treated as a subspecies of *Equisetum ramosissimum* rather than as a distinct species because of extensive intergradation in the area of overlap between the two subspecies (Hauke 1963). Intermediate forms are reported from S China, India, and Ryukyu Islands [Hauke, Beih. Nova Hedwigia 8 (1963) 1–123].

Uses — Used externally in Indonesia and Malaysia to treat bruises, wounds, fractures, arthritis. Also used internally to treat dysentery and hemorrhoids.

MATONIACEAE

(Masahiro Kato, Tokyo, Japan)

Matoniaceae C. Presl, Gefässb. Stipes Farnn (1847) 32; Copel., Gen. Fil. (1947) 173; Holttum, Revis. Fl. Malaya 2 (1955) 58; K.U. Kramer in Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 183.

Rhizomes creeping, dorsiventral, polycyclic-solenostelic, densely covered by light-brown or brown hairs. *Leaves* alternate on the dorsal side of rhizome; stipes polished, glabrous; lamina either pedate with pectinate pinnae, or alternately pinnate with pinnae consisting of resting buds or bud-derived leaflets and linear, simple or forked pinnules; veins free or anastomosing in soriferous parts. *Sori* round or elliptic, in one row on either side of costule or midrib; indusia thick-stalked, peltate, thick in central portion and membranous and inrolled in marginal portion; sporangia in one or a few layers around receptacle, consisting of short, thick stalk and capsule with incomplete oblique annuli. *Spores* tetrahedral, trilete. Gametic chromosome number $n = 25$ or 26 .

DISTRIBUTION

The family *Matoniaceae* is restricted to Malesia.

HABITAT AND ECOLOGY

The family has two markedly different ecological preferences: *Matonia* grows in more or less open places in often mossy mountain ridges or summits, and *Phanerosorus* on vertical walls of limestone rocks or caves.

TAXONOMY AND AFFINITY

The family shows a unique combination of vegetative and reproductive characters, and affinities to other families are remote and uncertain. Molecular data suggest that *Matoniaceae*, like other primitive families, diverged near the base of a phylogenetic tree of leptosporangiate ferns [Hasebe et al., Proc. Acad. Nat. Sc. USA 91 (1994) 5930–5934]. The family consists of two genera, *Matonia* and *Phanerosorus* which are distinct in leaf organization and also differ in sori, sporangia, spores, and gametophytes. The leaves of *Phanerosorus* resemble those of young plants of *Matonia* [Tansley & Lulham, Ann. Bot. 19 (1905) 475–519].

FOSSILS

Fossils of 11 or more genera are known from the Upper Triassic and Upper Cretaceous. In contrast to the present narrow range, they were widely distributed throughout the world: Eurasia, Australia including Tasmania, Africa and Madagascar, North and South Americas, and Greenland. Fossil leaves resemble those of extant *Matonia*.

KEY TO THE GENERA

- 1a. Leaves pedate; pinnae pectinate **Matonia** (p. 290)
 b. Leaves pinnately compound; pinnae bearing resting buds or bud-derived leaflets; pinnules linear, simple or forked **Phanerosorus** (p. 292)

MATONIA

Matonia R. Br. in Wall., Pl. Asiat. Rar. (1829) 16, t. 16; Copel., Gen. Fil. (1947) 172; Holttum, Revis. Fl. Malaya 2 (1955) 59, f. 13; K.U. Kramer in Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 183, f. 95, 96; M. Kato, Blumea 38 (1993) 167–172. — Type species: *Matonia pectinata* R. Br.

Rhizomes creeping, branched, tricyclic-solenostelic, densely hairy, hairs brown, multicellular, uniseriate, up to 5 mm long. *Leaves* borne alternately in two rows on the dorsal side of rhizome; stipe brown to chestnut-brown, hairy at base, glabrous above, much longer than lamina; lamina umbrella-like and perpendicular to stipe, pedate with a central pinna, coriaceous; pinnae 10–30, pectinate, deeply lobed, linear, marginal pinnae shorter; costae glabrous or hairy underneath; pinna-segments linear-oblong, entire, polished on the adaxial surface, often glaucous, papillate on the abaxial surface; veins forming costal areoles, forked, usually free or sometimes weakly anastomosing in sterile portions of segments, regularly anastomosing in soriferous portions (sori supplied by 5–7 veinlets branched from circular veins). *Sori* round, in one row along each side of costa or midrib; indusia 1–1.1 mm in diam., peltate, hemispherical, thick in central portion and membranous and inrolled in marginal portion, margin 0.4 mm broad; sporangia 5–10 in one layer; capsules globose-polygonal; annuli meandering. *Spores* tetrahedral, trilete, pale. — **Fig. 1a–c.**

Distribution — *Malesia*.

Taxonomy — Two species. In Blumea 38 (1993) 167–172 a statistical analysis is given the outcome of which justifies their separation.

Habitat & Ecology — In open places often in clearings, and in and at edge of mossy forest on mountain ridges or summits; from lowland to mountain.

Chromosome number — According to Manton in Holttum, Ferns of Malaya (1955), $n = 26$.

Gametophytes — The gametophytes grown in culture are massive, with a thick central cushion and much folded, glabrous wings on both sides of it. Antheridia and archegonia are massive, composed of many cells, and of a primitive type. See Stokey & Atkinson, Phytomorphology 2 (1952) 138–150.

KEY TO THE SPECIES

- 1a. Number of pinnae 19 or more, rarely fewer in extremely small leaves; pinna-segments usually strongly oblique and falcate; costae glabrous beneath at maturity **1. M. pectinata**
 b. Number of pinnae 15 or less, rarely up to 17; pinna-segments subpatent or oblique, straight or only moderately falcate; costae usually hairy beneath **2. M. foxworthyi**

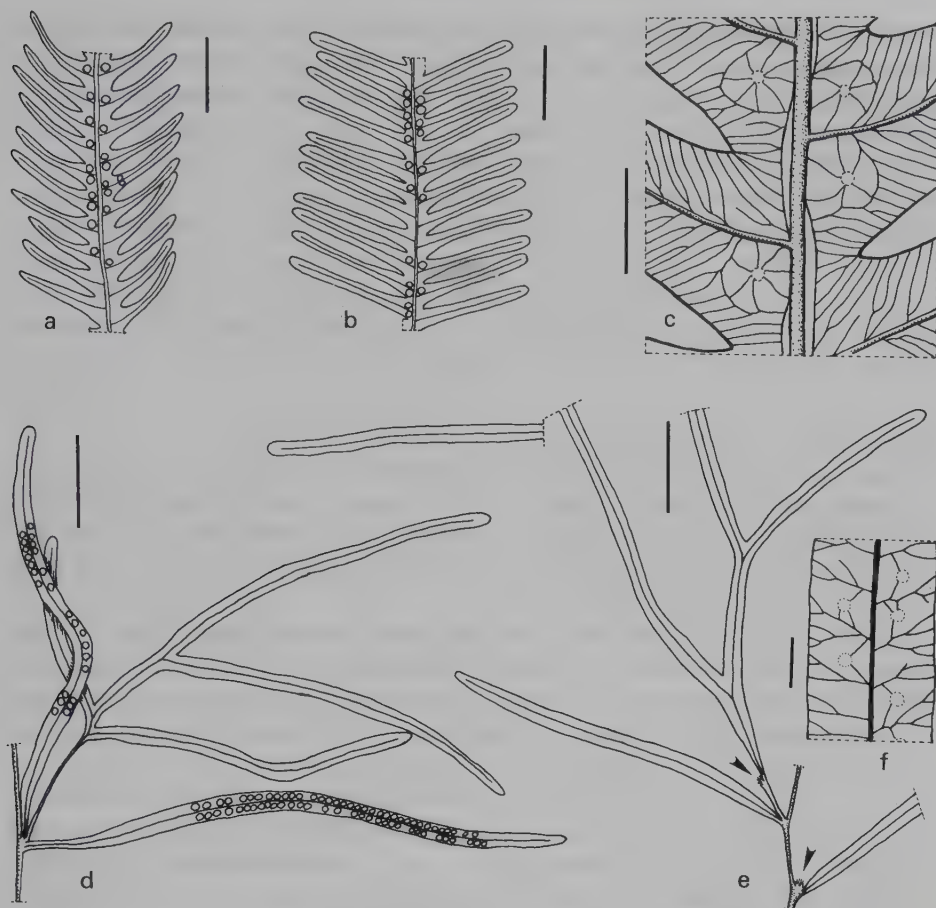


Fig. 1. *Matonia pectinata* R. Br. a. Part of pinna; c. part of pinna showing venation. — *M. foxworthyi* Copel. b. Part of pinna. — *Phanerosorus sarmentosus* (Baker) Copel. d. Pinna consisting of a pair of lateral primary pinnules and a forked secondary one. — *P. major* Diels. e. Two pinnae; the upper pinna consists of a basicopic primary pinnule and a bud-bearing secondary one, the lower one consists of a basicopic pinnule and a bud; f. part of fertile pinnule showing venation. — Scale bars = 2 cm for a, b, d, e; 2 mm for c, f.

1. *Matonia pectinata* R. Br.

Matonia pectinata R. Br. in Wall., Pl. Asiat. Rar. 1 (1829) 16, t. 16; Bedd., Ferns Brit. India 2 (1866) 186, pl. 186; Handb. Ferns Brit. India (1883) 19, f. 8; Copel., Sarawak Mus. J. 2 (1917) 388; Holttum, Revis. Fl. Mal., ed. 2, 2 (1968) 59, f. 13; Parris et al., Pl. Mt Kinabalu 1 (1992) 93, p.p., excl. specim. ex Kinabalu; M. Kato, Blumea 38 (1993) 172. — Type: *Farquhar s.n.* (K or CAL), Peninsular Malaysia, Malacca, Mt Ophir (at present Johor, G. Ledang), anno 1815.

Rhizome (excluding hairs) up to 8.5 mm (mean 6.4 mm) thick. **Leaves:** stipes brown or chestnut-brown, glabrous, up to 115(–180) cm (mean 82 cm). Lamina up to 50(–75) by 55(–80) cm (mean 35 by 42 cm), pedate; pinnae up to 30 (mean 22), deeply pectinate; central pinnae up to 50(–75) by 3.5(–5.5) cm (mean 35 by 2.7 cm); costae gla-

brous on the abaxial side but rarely hairy in young leaves; segments usually strongly oblique and falcate, linear-oblong, up to 6.2(–7.3) mm (mean 5.4 mm) broad at base. Annulus cells of *sporangia* 17–24 (mean 19.3). *Spores* 48–68 mm in diameter (mean 53 mm); surface granulate. — **Fig. 1a, c.**

Distribution — *W Malesia*: Peninsular Malaysia, Sumatra, Lingga Archipelago, Riau Archipelago. See note.

Habitat — In exposed area or in scrub on mountain ridges or on summits; altitude (90–)750–2000 m.

Note — One specimen (*Lobb 481*, BM) was assumedly collected in Java, but most certainly this is a wrong location. The report from New Guinea [Tan & Tolentino, Philipp. J. Sc. 116 (1987) 435–443] is perhaps due to misidentification.

2. *Matonia foxworthyi* Copel.

Matonia foxworthyi Copel., Philipp. J. Sc., Bot. 3 (1908) 343, pl. 2; Sarawak Mus. J. 2 (1917) 388; Alderw, Philipp. J. Sc., Bot. 11 (1916) 114; C. Chr. & Holttum, Gard. Bull. Str. Settlem. 7 (1934) 223; K. Iwats. & M. Kato, Acta Phytotax. Geobot. 35 (1984) 61; Tan & Tolentino, Philipp. J. Sc. 116 (1987) 536, pl. 2; M. Kato, Blumea 38 (1993) 171. — Type: *Foxworthy 372* (holotype destroyed, MICH iso), Borneo, Sarawak, Mt Po.

Rhizome (excluding hairs) up to 7 mm thick (mean 5.8 mm). *Leaves*: stipes brown or chestnut-brown, glabrous, up to 150 cm long (mean 85 cm). Lamina up to 45(–55) by 50(–60) cm (mean 35 by 41 cm), pedate; pinnae up to 15(–17) (mean 13), pectinate; central pinnae up to 45(–55) by 5(–6) cm (mean 36 by 3.9 cm); costae hairy beneath with brown or chestnut-brown crisped hairs, glabrous in very old leaves; pinna-segments linear-oblong, up to 6.2(–7.8) mm (mean 5.3 mm) broad at the base, subpatent or oblique, straight or only moderately falcate. Annulus cells of *sporangia* 14–25 (mean 18.7). *Spores* 50–70 mm in diameter (mean 61 mm); surface granulate. — **Fig. 1b.**

Distribution — *Malesia*: Borneo (Sarawak, Sabah, Kalimantan), Philippines (Mindoro, Sibuyan), Moluccas (Ambon), New Guinea (Irian Jaya).

Habitat — In more or less open places often in clearings, and in and at edge of mossy forest on mountain ridges or summits; altitude (420–)750–2100 m.

Notes — 1. New Guinean specimens [*van Royen & Sleumer 7204* (L), *Kanehira & Hatusima 14039* (BO)] have small leaves with 11 pinnae and hairy costae.

2. One specimen (*Anonymous collector*, BM) was collected from Mt Ophir, Peninsular Malaysia, where many specimens of *M. pectinata* have been collected; detailed field observation and new collection is needed.

PHANEROSORUS

Phanerosorus Copel., Philipp. J. Sc., Bot. 3 (1908) 344, pl. 3; Gen. Fil. (1947) 172; K. U. Kramer in Kubitzki (ed.), Fam. & Gen. Vasc. Pl. 1 (1990) 183, f. 95. — Type species: *Phanerosorus sarmen-tosus* (Baker) Copel.

Rhizomes creeping, branched, dicyclic-solenostelic, densely hairy; hairs light-brown, multicellular, uniseriate, up to 4 mm long. *Leaves* pendulous, pinnately compound,

pinnately lobed at apex; stipes straw-coloured, glabrous throughout, round on the abaxial side and somewhat flattened on the adaxial side; rachis, like stipe, stramineous and glabrous, narrowly winged on both lateral-adaxial sides as the uppermost part of the stipe; pinnae alternate, mostly consisting of two opposite primary pinnules and densely hairy buds sunken in a crater between them, or consisting of basiscopic primary pinnules and buds, or sometimes of secondary pinnules (devoid of primary pinnules) and buds near the base of pinnule or bud-derived leaflet, upper pinnae simpler than the middle; buds borne singly at the apex of pinna or up to nine additional buds borne near the base of leaflet stipes, dormant or developed into leaflets which are variable from small, single or forked secondary pinnules to large leaf-like leaflets; primary pinnules (the edge of which is decurrent to the rachis-wing) and secondary pinnules (whose edge is not continuous with the rachis-wing) near the base of leaflets simple to twice forked; pinnule-segments linear, up to 5 mm broad when fertile, up to 6(–7) mm broad when sterile, subcoriaceous or coriaceous, entire or subundulate at edge, polished on the adaxial surface, often glaucous and papillate on the abaxial surface; veins in sterile pinnule-segments free, once or twice forked, in fertile ones 2–4 times forked, soriferous veins usually anastomosing, veins in sterile portions free. *Sori* round or elliptic and hemispherical, in one median or inframedian row on each side of midrib, supplied by 1–3 veinlets; indusia peltate, thick in central portion and membranous and inrolled in marginal portion; sporangia about 20 in two or rarely three, more or less regular layers, consisting of a short, thick stalk and an elliptic-globose capsule with incomplete oblique annulus. Spores tetrahedral, trilete, pale. — **Fig. 1d–f.**

Distribution — Two species, both in *Malesia*.

Habitat & Ecology — Calcicolous and hanging from steep limestone cliffs or rocks, often at caves; locally abundant.

Morphology — The leaf morphology of *Phanerosorus* is similar to that of the small leaf of young *Matonia* plants [Tansley & Lulham, Ann. Bot. 19 (1905) 475–519], in particular in that the pinna-segments of young *Matonia* plants are unequally forked, as are the pinnules of *Phanerosorus*. The remarkable difference in leaf morphology of the genera is suggested to be due to heterochrony (paedomorphosis).

There are two kinds of leaf buds. One is a terminal bud at the apex of a pinna, and the other is an adventitious bud near the base of bud-derived secondary pinnules or leaflets. Leaf buds may develop into leaflets ranging from simple pinnules to large leaf-like leaflets; thus the leaves can grow indeterminately.

Chromosome number — According to Walker & Jermy, $n = 25$ [Fern Gaz. 12 (1982) 209–213].

Gametophytes — The gametophytes are long-lived and may occur abundantly together with the sporophytes of various ages on limestone rock surface. See Yoroi & Kato, Amer. J. Bot. 74 (1987) 354–359. Young gametophytes are slender, ribbon-like and one cell thick throughout, and old ones have cushions along the elongate thallus. They are usually monoecious and protandrous. Both young and old gametophytes reproduce vegetatively by proliferation of marginal cells of the thallus.

KEY TO THE SPECIES

- 1a. Pinna usually consisting of two opposite primary pinnules and a bud or bud-derived leaflet between them **1. *P. sarmentosus***
 b. Pinna consisting of a bud or bud-derived leaflet and one basiscopic primary pinnule or only of a bud or leaflet (primary pinnules lacking) **2. *P. major***

1. *Phanerosorus sarmentosus* (Baker) Copel.

Phanerosorus sarmentosus (Baker) Copel., Philipp. J. Sc., Bot. 3 (1908) 344, pl. 3; Sarawak Mus. J. 2 (1917) 388. — *Matonia sarmentosa* Baker, J. Linn. Soc. Bot. 24 (1887) 256. — Type: *Hose 216* (K), Borneo, Sarawak.

Rhizomes creeping, branched, up to 3 mm thick, densely covered with light-brown hairs. *Leaves* to 80(–130) cm long including the up to 20 cm long stipe, 25 cm broad; pinnae alternate, up to 22 on either side of rachis, up to 6(–9) cm apart, most pinnae consisting of two opposite primary pinnules and a bud or bud-derived leaflet between them, lower pinnae deciduous; buds one or two per pinna, rarely more; pinnules simple or once or twice forked, up to 20 cm long; pinnule-segments linear, entire or undulate at edge, fertile segments up to 5 mm broad, sterile ones up to 6(–7) mm broad; veins free but anastomosing in soriferous area, 2 or 3 times forked. *Sori* in one row on either side of midrib, supplied by one (veins free) or two or rarely three veinlets; indusial scars slightly raised; indusia brown, round or elliptic, up to 1.6 mm long, 1.4 mm broad, 1.1 mm tall. *Spores* 50–63 mm in diam.; surface granulate-verrucose. — **Fig. 1d.**

Distribution — *Malesia*: Borneo (Sarawak).

Habitat — Epipetric on and hanging from steep limestone cliff or on rock surface; 50–800 m altitude.

2. *Phanerosorus major* Diels

Phanerosorus major Diels, Notizbl. Bot. Gard. Mus. Berlin-Dahlem 11 (1932) 311; M. Kato, Acta Phytotax. Geobot. 40 (1989) 82. — Type: *Stein 212* (B; GH fragment), New Guinea, Waigeo Isl.

Rhizomes up to 2.5 mm thick, branched, densely covered by light-brown multicellular hairs. *Leaves* clustered or remote, up to 65 by 30 cm including the up to 15 cm long stipe, pinnate; pinnae alternate, up to 7 or 8 on either side of rachis, up to 3 cm apart, each consisting of either basiscopic primary pinnule and a bud or bud-derived leaflet at the base, or only bud or leaflet (primary pinnules lacking), a few lowest ones usually deciduous; pinnules simple to once or twice forked, stalked or sessile, up to 15 cm long (those of young plants longer); pinnule-segments linear, entire or subundulate at edge, coriaceous, fertile segments 3–5 mm broad, sterile segments up to 6(–7) mm broad; buds 1–10 (one primary and the others adventitious) per pinna; veins free, once or twice forked, or anastomosing in soriferous portions. *Sori* in one row along either side of midrib, supplied by 2 or 3 veinlets; scars of indusial stalks prominently raised; indusia brown or dark brown, peltate, thick, round or elliptic, up to 1.9 by 1.4 mm, up to 1.8 mm tall. *Spores* 55–63 mm in diam.; surface granulate. — **Fig. 1e, f.**

Distribution — *Malesia*: Moluccas (Seram), Waigeo, Misool, Aru, NW New Guinea.

Habitat — Epipetric on and hanging from steep limestone cliff or rock surface; from sea level up to 600 m altitude.

PLAGIOGYRIACEAE

(X.C. Zhang, Beijing, China & H.P. Nooteboom, Leiden, The Netherlands)

Plagiogyriaceae Bower, Ann. Bot. 40 (1926) 484.

Terrestrial ferns, small to medium sized, 10–150 cm, rarely up to 2 m high, devoid of scales. *Rhizome* stout, thickened, with persistent stipe bases, erect or suberect, or short decumbent, dictyostelic, sometimes bifurcate or stoloniferous; roots blackish, sparsely branched, wiry, regularly arranged on the stem, one beside each stipe base. *Fronde*s dimorphous, bearing minute, uniseriate, multicellular, gland-headed, mucilage-secreting trichomes, of which most are lost when dry, or becoming amorphous flaky ‘scales’ at the secretion. *Stipes* round, oval, triangulate, or tetragonal, bearing aerophores or not; base of stipe swollen, flat on ventral face and with a strong median ridge on the dorsal face and dividing this into two surfaces, each of which bears a row of warts looking like aerophores; the stipe with a single vascular bundle which expands or divides into three meristemes in the enlarged base; rachis winged or not, ventral face sulcate, dorsal face terete, flat, or carinate, aerophores absent, or present near the base of the pinnae. Laminae of *sterile fronds* herbaceous to subcoriaceous, glaucous below or not, once pinnate or deeply pinnatifid; pinnae falcate to linear-lanceolate, glabrous or sparsely glandular hairy underneath, margin entire, minutely serrulate to dentate at the apex; veins simple or paired at base, mostly once to twice forked, reaching the margin of a pinna. Laminae of *fertile fronds* similar in shape as the sterile ones, in the middle of a plant, erect, with a proportionally longer stipe and a shorter lamina, once pinnate or deeply pinnatifid, pinnae short stalked or sessile, glabrous or with few short glandular hairs at the edge, the tissue above the veinlets hygroscopic and reversible, functioning as indusium (‘false indusium’), at young stage the scarious margins covering the sori, recurved at mature stage, but when wet covering the sori again; veins free, once to twice forked, solitary or paired at the base, not entering into the scarious marginal part, margin of fertile pinnae entire or irregular, apical pinna usually pinnatifid or conform to the lateral ones, having a few lobes at base or not. *Sori* borne on the swollen end of veins, extended a little, confluent, ascrostichoid, nearly fully covering the lower surface of pinnae when ripe; paraphyses many, a little longer than sporangia, uniseriate, multicellular, orange to dark brown, gland-like, apically slightly capitate, deep in colour intermingled with sporangia. *Sporangia* with a complete oblique annulus, not interrupted by the stalk, lateral in dehiscence, 64 spores per sporangium. *Spores* tetrahedral-globose, trilete, the laesurae about 3/4 the radius, surface ornamentation irregular coarse tubercles, with coalescent papillae and rodlets.

Plagiogyriaceae is a monotypic family in the leptosporangiate Pteridophyta.

DISTRIBUTION AND ECOLOGY

Plagiogyria has an interesting amphi-Pacific disjunct distribution. In Asia it occurs north from Japan, South Korea (Cheju Island), to South China, westwards to East Himalayas ending on the south slope of Central Himalayas, in India only common at the far

eastern corner, not extending southwards on the subcontinent, and eastwards extending southwards via Indochina to Malesia, the Bismarck Archipelago, and the Solomon Islands. In tropical America it is found from Mexico to the Caribbean and the Andes of Venezuela, extending south to Bolivia and southeastern Brazil. The present distribution centre of *Plagiogyria* is in South and Southwest China. Eight species are found in China, most very common and abundant. *Plagiogyria assurgens* is the only species endemic to China. Second to China, six species and one variety are found throughout the Philippines and, except the one variety shared with Borneo, all six species are shared with Taiwan and South to Southwest China. This distribution is not often found in other groups of ferns. Those six species reached the Philippines perhaps by way of mainland China via Taiwan. Iwatsuki & Price (1977) commented that the Himalaya-Taiwanese floral component of northern Luzon is not a relict but recent. It is noted that *P. falcata*, *P. euphlebia*, and *P. stenoptera* in the Philippines are restricted in distribution and their populations are small. Japanese islands are also very rich in species; five occur there and all are rather common, except *P. stenoptera* which is found only in Yakushima Island. This species has a disjunct distribution between SW China, Taiwan and northern Luzon, and this case falls within many other examples of ferns that have a disjunctive distribution from SW China or East Himalayas to Taiwan and Japan. *Plagiogyria matsumureana*, an interesting endemic Japanese species, is the only summer-green species of *Plagiogyria*. It is the only extant relative of the tropical American species, *P. pectinata*. These two species are so similar that they are nearly unseparable morphologically and it seems that the only possible explanation of the origin of the American species is that it is derived from a common ancestor in Asia. Unlike the Sino-Himalaya, or Sino-Japan distribution groups, *Plagiogyria* is not well developed in the Indian subcontinent. The fact that none of them occurs in Africa, Australia and the lower part of India may shed light on the explanation of the historical biogeography of *Plagiogyria*. A few species in the north and northeastern corner of India are probably recently dispersed from the east. *Plagiogyria* has a wide extension in the islands of SE Asia, but most species are restricted to higher mountain forests. The four distinct local varieties of *P. egenolfioides* are morphologically and ecologically different. *Plagiogyria egenolfioides* var. *sumatrana* is distributed from Sumatra to Peninsular Malaysia, not uncommon at 1300-1800 m high ridges. The plants are usually large, the leaves have an elongate pinna-like apex and resemble *P. euphlebia*. *Plagiogyria egenolfioides* var. *decrescens* is the commonest high altitude fern in New Guinea and ranges from 1800 to about 4000 m. In the summit grasslands, this variety forms large dense populations often associated with *Blechnum vestitum* and it reaches eastwards into the Solomon Islands, and to the north into the Moluccas (Seram). Two other varieties occur in Borneo, the Philippines, Sulawesi, and east to Seram. In the Pacific *P. egenolfioides* var. *decrescens* and *P. glauca* were once collected on the summit of Mt Popomanatsen in Guadalcanal (Solomon Islands). The geographic distribution may be explained by the fact that all *Plagiogyria* species are mountain plants, abundant on cold, moist, forested high ridges. Most, if not all, are growing in acid peaty soil (Holttum 1966). Most of the plants can form large dense populations, and are dominant herbs in the undergrowth. Some species have a forked rhizome, or form runners to propagate vegetatively.

References: Holttum, R.E., A revised Flora of Malaya II. Ferns of Malaya. Ed. 2 (1966). Government Printing Office, Singapore. — Iwatsuki, K. & M.G. Price, The Pteridophytes of Mt. Burnay and vicinity, northern Luzon. South East Asian Studies 14 (1977) 540–572.

MORPHOLOGY

Rhizome — The morphology and anatomy of the rhizome and stipe were studied in detail in some species by Bower (1910), Nayar & Kazmi (1962), and Ogura (1972).

The rhizome is erect, suberect, or decumbent, a few to c. 15 cm long. Long rhizomes in *P. egenolfioides* var. *latipinna* and var. *decrescens* are up to 50 cm and still upright, only the stipe bases are relatively sparsely arranged. Short decumbent rhizomes are occasionally found in *P. euphlebia*, *P. falcata*, and *P. adnata*; there are no essential differences in anatomy from the erect ones. The shape of the rhizome is subject to change with the environmental condition. The long rhizome specimens are plants growing in soil covered by a thick moss layer.

Occasional stolons (runners) occur in *P. glauca* and *P. pycnophylla*. The stolon is interesting in anatomy. Its basal part shows a protostele, enlarges into a solenostele and then a dictyostele, showing all stages of ontogenetic development (Ogura 1972).

Stipe — There is no difference between the stipes of sterile fronds and those of the fertile ones in one species. Usually, the fertile frond has a longer stipe, but shorter stipes occur in some populations of *P. euphlebia* and in *P. egenolfioides*.

Cross sections of stipes, especially from the middle part of the swollen bases, are valuable in taxonomic studies of this genus. All the species except *P. matsumureana* and *P. pectinata* (not in Malesia) have one *Loxsoma*-type stele in the stipe, V- or U-shaped, surrounded by a sclerenchyma sheath. In the two above mentioned species the stele is V-shaped at the very base but a few millimetres higher it divides into three meristyles.

Plagiogyria egenolfioides var. *decrescens*, var. *latipinna*, var. *sumatrana*, *P. glauca*, and *P. pycnophylla* form a group characterised by a thick sclerenchyma sheath surrounding the vascular bundle. The latter is U-shaped in cross section when cut off at the middle part of a stipe base. In *P. egenolfioides* var. *egenolfioides* the plants are very small and the vascular bundle is V-shaped in cross section. *Plagiogyria assurgens* has one U-shaped vascular bundle surrounded by a thin layer of sclerenchyma. In large plants of *P. euphlebia* the vascular bundle is U-shaped, in smaller plants it is V-shaped. *Plagiogyria adnata*, *P. falcata*, and *P. stenoptera* (and *P. japonica* outside Malesia) are species with a thin sclerenchyma sheath around the V-shaped vascular bundle. *Plagiogyria matsumureana* and *P. pectinata* (not in Malesia) are two very exceptional species with three vascular bundles each surrounded by a thin sclerenchyma sheath.

The distinction of so-called U-shaped or V-shaped vascular bundles in some species is not very clear. For example, most cross sections made at the middle of stipe bases in *P. stenoptera* show an arch with two divergent arms. The bottom has a roundish angle, which is called V-shaped; in some bigger specimens the stipe base is more dorsiventral and the vascular arch's bottom is horizontal, referred to as U-shaped. There is a gradual transition of the vascular bundle from U-shaped to V-shaped. The apomorphic state is a divided stele. It is clearly shown this is a V-shaped stele at the beginning, that divides

into three strands. Ontogenetically and phylogenetically the evolution of the stele is interesting in all the groups of *Plagiogyria*.

Aerophores — Aerophores (pneumatophores) are prominent on the dorsal side of swollen stipe bases. They form a common character of all *Plagiogyria* species. Hook-shaped aerophores up to 2 mm or more develop on stipes and on dorsal sides of rachises at the base of the insertion of pinnae in *P. egenolfioides* var. *decreescens*, var. *latipinna*, and var. *sumatrana*. Horn-like ones, usually c. 0.5 mm long, occur on the stipes and pinnae bases of *P. glauca* and *P. pycnophylla*. Nakai called them the *Polypneumatophorata* Group. They are also representatives of the most primitive members in *Plagiogyria* with a thick sclerenchyma shell around the vascular bundle in the stipes. In *P. egenolfioides* var. *egenolfioides*, and the dwarf plants of other taxa, the aerophores are not fully developed on the stipe and rachis, sometimes they even appear to be absent. Round, wart-like aerophores appear at the base of stipes of all other species (Nakai's *Paripneumatophorata* Group) and sometimes develop on the stipe and rachis of large specimens of *P. euphlebia*. In smaller specimens of *P. falcata* and *P. stenoptera* (also *P. matsumureana* and *P. pectinata*, not in Malesia) only very few small aerophores, usually 1 to 3 pairs, occur at the not much dilated bases. The development of aerophores correlates with that of the mechanical tissues (sclerenchymatic tissues) in the stipe and may function as an aeration pathway for the living parenchymatic tissues inside. Large stomata occur on the apex of aerophores.

References: Bower, F.O., Studies in the phylogeny of the Filicales, I. *Plagiogyria*. Ann. Bot. (1910) 24. — Nayar, B.K. & F. Kazmi, Ferns of India No. IV, *Plagiogyria*. Bull. Nat. Bot. Gard. Lucknow 64 (1962) 1–37. — Ogura, Y., Comparative anatomy of the vegetative organs of the Pteridophytes. In: Handbuch der Pflanzenanatomie, Ed. 2, VII, 3 (1972). Gebr. Borntraeger, Berlin.

PLAGIOGYRIA

Plagiogyria (Kunze) Mett., Abh. Senckenb. Naturf. Ges. 2 (1858) 265; Bedd., Ferns Brit. India 1 (1866) 51; J. Sm., Hist. Fil. (1875) 162; Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 281; C. Chr., Index Filic. (1906) 43; Alderw., Malayan Ferns (1908) 340; Malayan Ferns Suppl. 1 (1916) 243; Nakai, Bot. Mag. (Tokyo) 42 (1928) 204; Copel., Philipp. J. Sc. 38 (1929) 377; Backer & Posth., Varenfl. Java (1939) 30; Copel., Fern Fl. Philipp. 2 (1960) 193; Holttum, Revis. Fl. Malaya, ed. 2 (1966) 109. — *Lomaria* Blume, Enum. Pl. Javae (1828) 205, p.p.; Hook., Sp. Fil. 3 (1860) 2, p.p.; Racib., Pteridoph. Buitenzorg 1 (1898) 159, p.p. — *Lomaria* sect. *Plagiogyria* Kunze, Farnkräuter 2 (1850) 61, 63. — *Lomaria* § *Plagiogyria* Hook., Sp. Fil. 3 (1860) 19. — *Plagiogyria* sect. *Plagiogyria*, Ching, Fl. Reip. Popul. Sin. 2 (1959) 86. — Type: *Plagiogyria euphlebia* (Kunze) Mett. [*Lomaria euphlebia* Kunze].

Lomarium C. Presl, Epim. Bot. (1851) 154, p.p.

Polygramma C. Presl, Epim. Bot. (1851) 156, nom. inval. — Type: *Lomarium* ? *semicordatum* C. Presl.

Stenochlaena C. Presl, Epim. Bot. (1851) 162, p.p.

Plagiogyria subsect. *Adnatae* Ching ex Lellinger, Amer. Fern J. 61 (1971) 111. — Type: *Plagiogyria adnata* (Blume) Bedd.

Plagiogyria sect. *Carinatae* Ching ex Lellinger, Amer. Fern J. 61 (1971) 111. — Type: *Plagiogyria argutissima* H. Christ.

Plagiogyria subsect. *Pycnophyllae* Ching ex Lellinger, Amer. Fern J. 61 (1971) 111. — Type: *Plagiogyria pycnophylla* (Kunze) Mett.

KEY TO THE SPECIES

- 1a. Most pinnae of sterile lamina (except the uppermost) auriculate, margin of pinnae of sterile lamina crenate **2. *P. egenolfioides***
- b. Most pinnae of sterile lamina (except the uppermost) adnate to rachis or not, but not auriculate, margin of pinnae of sterile lamina (or except the apex) serrulate (sometimes towards base becoming entire or nearly so) 2
- 2a. Most pinnae of sterile lamina (except the uppermost) adnate to rachis or only the acroscopic side adnate 3
- b. Most pinnae of sterile lamina (except the uppermost) cuneate, rounded, truncate, or attenuate 6
- 3a. Aerophores present on stipe and rachis, cross section of stipe one U-shaped vascular bundle, fronds covered with an amorphous gelatinous mucilage layer when dry **2. *P. egenolfioides* (var. *latipinna*)**
- b. Aerophores only present on base of stipe, cross section of stipe one V-shaped vascular bundle, fronds not covered with an amorphous gelatinous mucilage layer when dry 4
- 4a. Most pinnae of sterile lamina (except the uppermost) with acroscopic side adnate into a wide wing along rachis, dorsal side of rachis semiterete or trigonous, fertile lamina pinnate except the apex, lower pinnae shortly stalked **1. *P. adnata***
- b. Most pinnae of sterile lamina (except the uppermost) adnate to rachis but not into a wing, dorsal side of rachis flattened or carinate, fertile lamina pinnate throughout, pinnae nearly sessile, or deeply pinnatifid and rachis slightly winged throughout 5
- 5a. Some pairs of lowermost pinnae of fertile lamina become aerophore-like vestiges on stipe together with aerophores, upper part of stipe tetragonal, dorsal side of the rachis of fertile lamina flattened or grooved, apex of fertile lamina terminated by a pinna conform to the lateral ones and often beaded at the base, base of middle pinnae of fertile lamina shortly stalked **7. *P. stenoptera***
- b. Lowermost pinnae of fertile lamina not or gradually shortened, upper part of stipe triangular, dorsal side of rachis of fertile lamina carinate, apex of fertile lamina pinnatifid, acuminate or caudate, base of middle pinnae of fertile lamina broadly adnate **4. *P. falcata***
- 6a. Aerophores cushion-like, rhizome short **3. *P. euphlebia***
- b. Aerophores slender, hook-shaped with pointed apex, or elongate, horn-like with blunt apex, rhizome short to c. 15 cm long, or occasionally up to 50 cm long . 7
- 7a. Aerophores elongate, horn-like, with blunt apex, fronds not covered with an amorphous gelatinous mucilage layer when dry, paraphyses few, mostly lost, spores yellow to brown, not obviously tuberculate 8
- b. Aerophores slender, hook-shaped with pointed apex, fronds covered with an amorphous gelatinous mucilage layer when dry, paraphyses many, spores yellow or brown, with reddish tubercles **2. *P. egenolfioides***
- 8a. Sterile lamina not glaucous, herbaceous, lowermost pinnae slightly shorter or gradually shortened **6. *P. pycnophylla***
- b. Sterile lamina glaucous beneath, firm herbaceous or subcoriaceous, not or abruptly shortened **5. *P. glauca***

1. *Plagiogyria adnata* (Blume) Bedd.

Plagiogyria adnata (Blume) Bedd., Ferns Brit. India 1 (1865) pl. 51; Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 291; Luer, Bot. Jahrb. Syst. 4 (1883) 365; Copel., Polypod. Philipp. Is. (1905) 97; Alderw., Malayan Ferns (1908) 342; Copel., Philipp. J. Sc., Bot. 3 (1908) 280; C. Chr., Acta Horti Gothob. 1 (1924) 92; Copel., Philipp. J. Sc. 38 (1929) 396; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 225; Holttum, Gard. Bull. Str. Settle. 9 (1937) 133; Backer & Posth., Varenfl. Java (1939) 31; Copel., Fern Fl. Philipp. 2 (1960) 195; Holttum, Revis. Fl. Malaya, ed. 2 (1966) 111; Parris et al., Pl. Mount Kinabalu 1 (1991) 97. — *Lomaria adnata* Blume, Enum. Pl. Javae (1828) 205; Hook., Sp. Fil. 3 (1860) 19, t. 147, excl. syn. *Lomaria scandens*; Racib., Pteridoph. Buitenzorg 1 (1898) 162. — Type: *Blume s.n.* (L sh. 908.315-140), Java.

Lomaria brooksii Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 32. — *Struthiopteris brooksii* Ching, Sunyatsenia 5 (1940) 243. — Type: *Brooks 333s* (holo BM), Sumatra, Benkoelen, Lebong Simpang, alt. 1400 m, VIII-1917.

Rhizome short, erect to suberect or curved, thick with many stipe bases. Stipes stramineous or brownish, of sterile fronds (4.5–)15–25(–35) cm long, of fertile fronds (17–)40–50(–65) cm long, base slightly to moderately enlarged, 2–7 mm wide in the middle, in cross section one V-shaped vascular bundle, upper part of stipe tetragonal or rarely triangular, aerophores only present on base of stipe; rachises glabrous. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete to trigonous, not winged, rachis (0.5–)1–1.5(–3) mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnatifid, rarely except a few free basal pinnae, widest basally to medially, (8–)15–25(–36) by (3–)5–15(–26) cm, index (1.3–)2(–3.5); pinnae (8–)13–20(–35) pairs, widest below or about the middle, veins of pinnae paired at base, forked above base, or rarely simple, distinct on both surfaces, stomata scattered on the lower epidermis, margin minutely serrulate but towards the base becoming entire or nearly so or nearly entire except the apex, most pinnae except the uppermost with inequilateral base, acroscopic side adnate into a wide wing along the rachis; lowermost pinnae adnate, not or slightly deflexed, not or slightly shortened; middle pinnae (1.5–)5–7(–11) cm long, (0.4–)0.7–1.2(–1.7) cm wide in the middle, acroscopic side of base adnate to the rachis into a wide wing, basiscopic side rounded, partly free from rachis; uppermost pinnae adnate, base about equal-sided, basiscopically decurrent into rachis wing; apex of lamina pinnatifid, terminated by a pinnatilobed, short- or long-triangular segment. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis flattened or slightly grooved, not winged, rachis (0.5–)1(–2) mm wide in the middle part; lamina pinnate except the apex, lower pinnae shortly stalked, (8–)16–26(–45) by (2–)4–10(–16) cm; pinnae glabrous or sparsely bearing short glandular hairs, (9–)13–17(–24) pairs, margin entire or subentire; lowermost pinnae not shortened, 1–4 cm apart; middle pinnae (1–)4–8(–11) cm long, 2–3(–4) mm wide, base sessile or shortly stalked; apex terminated by a pinna conform to the lateral one and often beaded at the base or pinnatifid, acuminate, or caudate. Paraphyses many or few, rarely mostly lost, yellow to brown. *Spores* yellow, with reddish tubercles. — **Fig. 1.**

Distribution — Japan, China (Anhui, Zhejiang, Fujian, Jiangxi, Hunan, Guangdong, Guangxi, Hainan, Taiwan, Sichuan, Guizhou, Yunnan), Burma, E India (Assam, Khasia, Shillong), Thailand, Vietnam; *Malesia*: Peninsular Malaya, Sumatra, Java, Borneo (Mt Kinabalu), Philippines (Luzon).



Fig. 1. Herbarium sheet of *Plagiogyria adnata* (Blume) Bedd. in NY.

Habitat — On rather wet forest mountain slopes; altitude 60–2000 m, common above 500 m; on Mt Kinabalu from 1400–1600 m.

Chromosome number — Nakato [J. Jap. Bot. 63 (1988) 214] reported $2n = 260$, under the name *Plagiogyria rankanensis* Hayata; Weng [Acta Phytotax. Sin. (1990) 27] reported $n = 60$, under the name *Plagiogyria distinctissima* Ching.

Notes — 1. Kuhn (1869) ascribed *P. adnata* to T. Moore, Ind. Fil., a manuscript name. Apparently he was unaware of the combination made by Beddome four years before.

2. A few sheets of *Hancock 216bis* in BM and K are all *P. stenoptera* (*Lomaria concinna*). Ching's original type of *P. yunnanensis* could not be traced in the above herbaria.

2. *Plagiogyria egenolfioides* (Baker) Copel.

Plagiogyria egenolfioides (Baker) Copel., J. Str. Br. Roy. Asiat. Soc. 63 (1912) 72; Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Sarawak Mus. J. 2 (1917) 387; Philipp. J. Sc. 38 (1929) 394; X. C. Zhang & Noot., Blumea 42 (1997) 483. — *Lomaria egenolfioides* Baker, Kew Bull. (1894) 7. — *Blechnum egenolfioides* C. Chr., Index Filic. (1906) 153. — Type: *Hose 309* (holo K; iso P, fragm. BM, photogr. PE), Sarawak, Mt Dulit, alt. 5000 ft, 1891.

For further synonymy see under the varieties.

Rhizome short to c. 15 cm long or occasionally up to 50 cm long, erect, suberect, or decumbent, narrow, sometimes very woody. *Stipes* reddish brown, of sterile fronds (0.5–)3–35(–72) cm long, of fertile fronds (2.5–)6–55(–88) cm long, base slightly, strongly, or moderately enlarged, 0.5–20 mm wide in the middle, cross section one U-shaped or one V-shaped vascular bundle, upper part of stipe tetragonal, terete, or oval, aerophores present on stipe and rachis, only on base of stipe, or seemingly absent when dry, slender, hook-shaped, with pointed apex (usually); stipes and rachises glabrous. Fronds usually in var. *latipinna* covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete, trigonous, flattened or grooved, not winged, rachis (0.2–)0.5–4(–5) mm wide in the middle part. *Sterile lamina* subcoriaceous, not glaucous, rather thick to rather thin but firm, pinnate except the pinnatifid or pinnatilobed apex or lower part pinnate, upper 1/3 to 1/2 pinnatifid, except a few free basal pinnae, or rarely pinnatifid throughout, widest medially to subbasally, (4–)12–74(–100) by (1–)2.5–22(–27) cm, index (1.68–)2–8(–11); pinnae (6–)17–60(–80) pairs, widest near base to about the middle, veins of pinnae simple, paired at base, forked above base, or simple as many as forked, distinct, obscure, or invisible on both surfaces, stomata scattered on the lower epidermis, margin (sometimes except the apex) entire, crenate or serrulate, most pinnae except the uppermost with equilateral or inequilateral base, acroscopic side adnate, cuneate, rounded, auriculate or attenuate; lowermost pinnae sessile, shortly stalked or rarely adnate but slightly constricted, deflexed or not, slightly, gradually, or abruptly shortened, not reduced or rarely some pinnae vestigial on stipe sided by aerophores; middle pinnae (0.5–)1–14(–20) cm long, (0.15–)0.4–1.4(–1.9) cm wide in the middle, sessile to shortly stalked, base rounded, cuneate, or auriculate; apex of lamina pinnatifid, terminated by a pinnatilobed segment or rarely by a pinna conform to lateral ones. *Fertile fronds* usually longer than the sterile ones, rarely shorter or about the same length, dorsal side of rachis semiterete, flattened or grooved, not winged, rachis 0.5–4(–5) mm wide in the middle part; lamina pinnate throughout, pinnae nearly sessile or shortly stalked, or pinnate except the apex and lower pinnae shortly stalked, or pinnate with stalked pinnae, uppermost pinnatifid, pinnae base decurrent, (6–)11–60(–100) by (0.7–)1.5–20(–30) cm; pinnae sparsely bear-

ing short glandular hairs or glabrous, 15–72 pairs, margin erose, entire, or subentire; lowermost pinnae the longest or gradually shortened, 0.5–4(–8) cm apart; middle pinnae (0.4–)0.8–14(–22) cm long, 1.5–6 mm wide, base slightly cordate, shortly stalked, or sessile (rarely auriculate or with one basispic lobe); apex pinnatifid, acuminate or caudate, rarely terminated by a pinna-like segment. Paraphyses many or few, mostly lost or absent, yellow, brown, or dark brown. *Spores* brown or yellow, with reddish tubercles.

KEY TO THE VARIETIES

- 1a. Plants small (dwarfed), aerophores obscure, only present on base of stipe **a. var. egenolfioides**
- b. Plants not dwarfed, aerophores distinct, present from base of stipe to the rachis 2
- 2a. Pinnae stalked, apex of sterile lamina usually terminated by a pinna conform to lateral ones **d. var. sumatrana**
- b. Pinnae subsessile or base adnate; apex of sterile lamina usually pinnatifid 3
- 3a. Lowermost pinnae gradually abbreviated **b. var. decrescens**
- b. Lowermost pinnae not abbreviated, or only 1 to 2 pairs shorter . **c. var. latipinna**

a. var. egenolfioides

Plagiogyria egenolfioides (Baker) Copel., J. Str. Br. Roy. Asiat. Soc. 63 (1912) 72; Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Sarawak Mus. J. 2 (1917) 387; Philipp. J. Sc. 38 (1929) 394; X.C. Zhang & Noot., Blumea 42 (1997) 483. — *Lomaria egenolfioides* Baker, Kew Bull. (1894) 7. — *Blechnum egenolfioides* C. Chr., Index Filic. (1906) 153. — Type: *Hose 309* (holo K; iso P, fragm. BM, photogr. PE), Sarawak, Mt Dulit, alt. 5000 ft, 1891.

Plagiogyria minuta Copel., Philipp. J. Sc., Bot. 10 (1915) 148; Alderw., Malayan Ferns Suppl. 1 (1916) 243; Copel., Sarawak Mus. J. 2 (1917) 387; Philipp. J. Sc. 38 (1929) 394, pl. 3. — Type: *Native collector 939* (not '393' by Copeland 1915) (holo MICH; fragm. BM, photogr. GH, PE), Sarawak, without exact locality.

Rhizome short, erect or decumbent, narrow. *Stipes* of sterile fronds (0.5–)3–13 cm long. *Fertile fronds* (2.5–)6–23 cm long, base slightly enlarged, 0.5–2 mm wide in the middle, cross section one U-shaped vascular bundle or one V-shaped vascular bundle (likely), upper part of stipe tetragonal to terete or oval, aerophores only present on base of stipe or seemingly absent when dry. Fronds covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete, grooved or flattened, rachis (0.2–)0.5–1(–1.5) mm wide in the middle part. *Sterile lamina* rather thick, pinnate except the pinnatifid or pinnatilobed apex, widest medially, (4–)14–36 by (1–)2.5–5.5 cm, index (4–)5–7.8; pinnae (13–)20–38 pairs, widest basally, veins of pinnae simple (or forked), invisible on both surfaces, margin crenate, most pinnae except the uppermost with equilateral or inequilateral base, auriculate; lowermost pinnae sessile, deflexed, gradually shortened; middle pinnae (0.5–)1–2.5 cm long, (0.15–)0.4–0.6 cm wide in the middle, sessile, base auriculate (auricle up to 0.8 cm long, and pinnatilobed); apex of lamina pinnatifid, terminated by a pinnatilobed segment. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis semiterete or grooved or flattened, rachis 0.5–1 mm wide in the middle part; lamina pinnate throughout, pinnae shortly

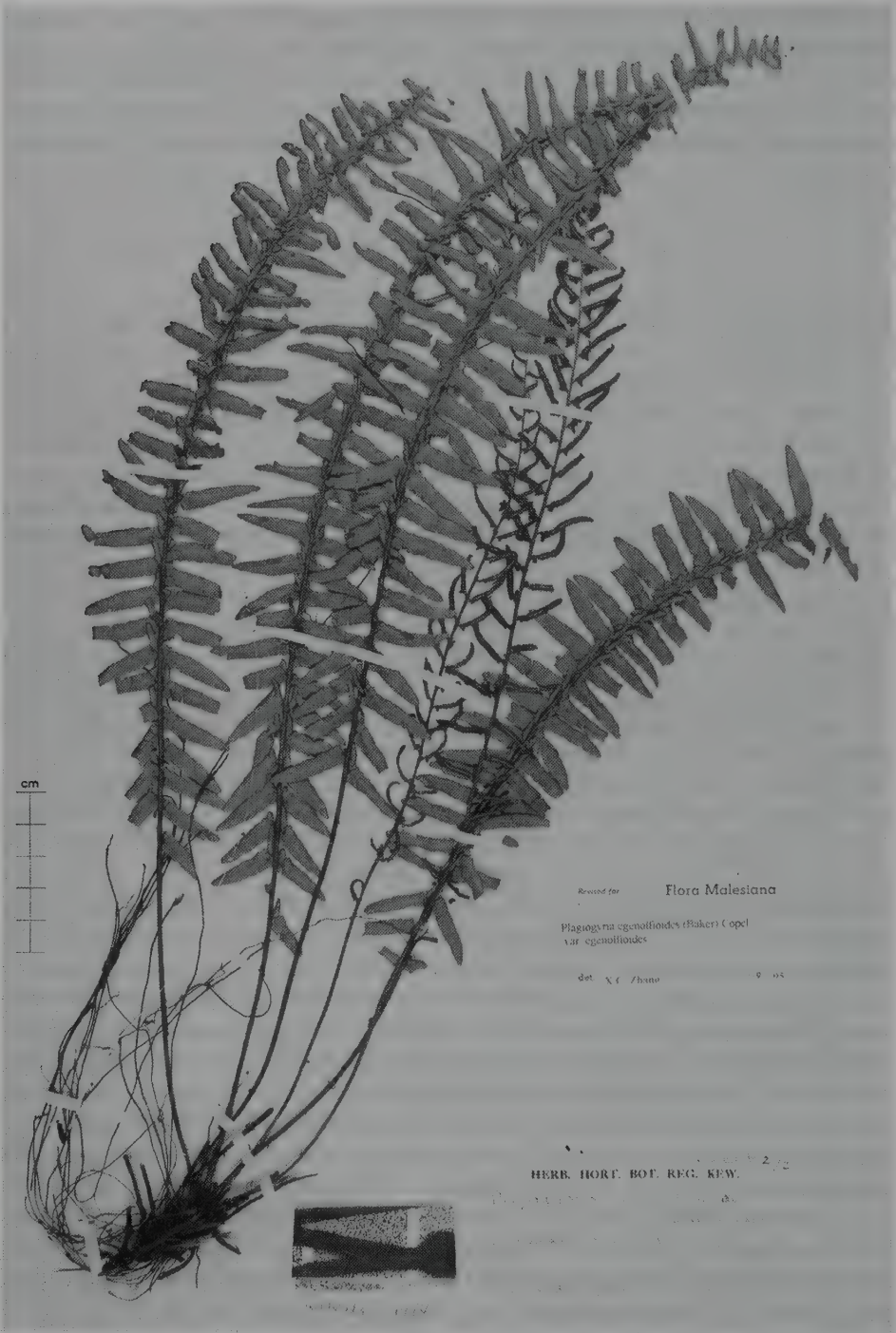


Fig. 2. Herbarium sheet of *Plagiogyria egenolfioides* (Baker) Copel. var. *egenolfioides* in K.

stalked or nearly sessile, (6–)11–25 by (0.7–)1.5–3.5 cm; pinnae glabrous, 22–28 pairs, margin erose; lowermost pinnae gradually shortened, 0.5–0.8 cm apart; middle pinnae (0.4–) 0.8–1.5 cm long, 1.5–2 mm wide, base shortly stalked or slightly cordate (or auriculate, sometimes with one basiscopic lobe); apex pinnatifid, acuminate or caudate. Paraphyses few, mostly lost or absent, dark brown. *Spores* brown, with reddish tubercles. — **Fig. 2.**

Distribution — *Malesia*: Borneo, endemic in Sarawak (3 collections from Mt Dulit).

Habitat — On shaded sandstone cliff, growing with *Dipteris conjugata*; altitude 1230–1500 m.

b. var. *decrescens* (C. Chr.) X. C. Zhang & Noot.

Plagiogyria egenolfioides (Baker) Copel. var. *decrescens* (C. Chr.) X. C. Zhang & Noot., *Blumea* 42 (1997) 483. — *Plagiogyria tuberculata* var. *decrescens* C. Chr., *Brittonia* 2 (1937) 284. — Type: *Brass* 4746 (holo BM; fotogr. PE), Papua New Guinea, Central Prov., Wharton Range, Murray Pass, alt. 2840 m, 8-VIII-1933.

Blechnum pendulum Brause, *Bot. Jahrb. Syst.* (1920) 157. — *Struthiopteris pendula* Ching, *Sunyatsenia* 5 (1940) 243. — *Plagiogyria pendula* Chambers ex Nakaike, *Bull. Nat. Sc. Mus. Tokyo* 17 (1991) 92, f. 13. — Type: *Ledermann* 11927 (holo B; fotogr. BM, PE), Papua New Guinea, Sepik, 'Baumkronen', alt. 2070 m, 2-VI-1913.

Plagiogyria novoguineensis Alderw., *Nova Guinea* 14 (1923) 36. — Type: *Lam* 1860 (holo BO, n.v.; fragm. L, fotogr. BM, K, PE), New Guinea, Doorman Summit, alt. 2950 m, 30-X-1920.

Plagiogyria papuana C. Chr., *Brittonia* 2 (1937) 285; Nakaike, *Bull. Nat. Sc. Mus. Tokyo* 17 (1991) 92. — Syntypes: *Brass* 4317 (BM, fotogr. PE), Papua New Guinea, Central Prov., Mt Albert Edward, alt. 3680 m, 23-VI-1933; *Brass* 4483 (BM, NY, fotogr. PE), alt. 3680 m, 10-VII-1933.

Plagiogyria tuberculata auct. non Copel.: C. Chr., *Brittonia* 2 (1937) 284.

Rhizome short to c. 15 cm long or occasionally up to 50 cm long, erect, suberect, or decumbent. *Stipes* reddish brown, of sterile fronds 6–35(–72) cm long, of fertile fronds 16–50(–88) cm long, base strongly or moderately enlarged, 5–15 mm wide in the middle, cross section one U-shaped vascular bundle, upper part of stipe tetragonal, aerophores present on stipe and rachis, slender, hook-shaped, with pointed apex. Fronds covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete to trigonous or grooved, rachis (1–)2–4(–5) mm wide in the middle part. *Sterile lamina* rather thick, lower part pinnate, upper 1/3 to 1/2 pinnatifid, widest medially, 12–74 by (1.5–)3–13(–26) cm, index (2.5–)5–8(–11); pinnae (strongly ascending) (18–)30–60(–80) pairs, widest below or about the middle, veins of pinnae simple to as many as forked, distinct to obscure on both surfaces, margin entire, most pinnae except the uppermost with inequilateral to equilateral base, rounded to cuneate; lowermost pinnae sessile to shortly stalked, not deflexed, usually gradually shortened, some pinnae vestigial on stipe sided by aerophores (sometimes a few pairs); middle pinnae (1.3–)3.5–7(–18) cm long, (0.3–)0.5–1 cm wide in the middle, sessile to rarely shortly stalked, base rounded or cuneate (when dry); uppermost pinnae adnate, base unequal-sided, basiscopically decurrent into rachis wing to perpendicular to the rachis; apex of lamina pinnatifid, sometimes terminated by a pinnatilobed or a pinna-like segment. *Fertile fronds* usually longer than the sterile ones, sometimes shorter (or about the same length, sometimes from the high grasslands), dorsal side of rachis semiterete, trigonous or grooved, rachis (1–)2–4(–5) mm wide in the middle part; lamina pinnate

except the apex, lower pinnae shortly stalked, 18–54(–90) by 3–12(–25) cm; pinnae sparsely short glandular hairy, 25–70 pairs, margin erose; lowermost pinnae gradually shortened, (0.8–)1–3(–6) cm apart; middle pinnae 3–14 cm long, 3–5 mm wide, base sessile, slightly cordate or shortly stalked; apex pinnatifid, acuminate or caudate. Paraphyses many, yellow to (glossy) brown. *Spores* brown, with reddish tubercles.

Distribution — *Malesia*: Sulawesi, Moluccas (Seram), New Guinea, S New Ireland, Solomon Islands (Guadalcanal); very common at high elevations in New Guinea.

Habitat — Forming large spots in fire-induced, treefern-dominated grasslands, and subalpine shrubbery, in primary cloud forest, rarely as epiphyte, altitude 1250–4000 m.

Chromosome number — Walker [J. Linn Soc. Bot. (London) 67, Suppl. 1 (1973) 91] reported $n = 66$ under the name of *Plagiogyria tuberculata* Copel.

Note — Hennipman [Blumea 16 (1968) 97] made a detailed study of the mucilage-producing glandular hairs on the base of stipes of this variety and *P. pycnophylla*. He found that the hairs of the two species show certain differences in orientation and in shape and size of stalk and capitate glandular cell. Our observations confirmed his report, but this character is not very useful in practice to distinguish species.

c. var. *latipinna* (Copel.) X.C. Zhang & Noot.

Plagiogyria egenolfioides (Baker) Copel. var. *latipinna* (Copel.) X.C. Zhang & Noot., Blumea 42 (1997) 484. — *Plagiogyria tuberculata* var. *latipinna* Copel., Philipp. J. Sc., Bot. 2 (1907) 133; Alderw., Malayan Ferns (1908) 826. — Type: *Merrill 5962* (iso GH, US, photogr. PE), Philippines, Mt Halcon, alt. 2400 m, XI-1906.

Plagiogyria tuberculata Copel., Philipp. J. Sc. 1, Suppl. (1906) 153; Alderw., Malayan Ferns (1908) 343; C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1927) 154; Copel., Philipp. J. Sc. 38 (1929) 391, p.p., excl. pl. Borneo, Sumatra; Fern Fl. Philipp. 2 (1960) 194, p.p., excl. pl. New Guinea, Borneo, Sumatra; K. Iwats. & M.G. Price, South East Asia Studies 14 (1977) 550; Parris, Stud. Fl. Gunung Mulu Nat. Park, Sarawak (1984) 177; M. Kato, Acta Phytotax. Geobot. 40 (1989) 91. — Type: *Copeland 1924* (holo MICH-Herb. E.B. Copeland No. 33), Luzon, Lepanto, Bagnen, alt. 6500 ft, 4-XI-1905.

Plagiogyria tuberculata var. *gracilis* Copel., Leaflet Philipp. Bot. 2 (1908) 405; Alderw., Malayan Ferns Suppl. 1 (1916) 244. — Type: *Elmer 9740* (BM, F, GH, K, L, NY, P, U, US), Philippines, Negros, Mt Cuernos, alt. 1800 m, IV-1908.

Plagiogyria pycnophylla var. *integra* Copel., Philipp. J. Sc., Bot. 5 (1910) 285; Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Sarawak Mus. J. 2 (1917) 388. — Type: *Brooks s.n.* (BM), Sarawak, Mt Bengkarum, Sambas River, alt. 3500 ft, IX-1908.

Plagiogyria pycnophylla var. *integra* subvar. *stenophylla* Bonap., Notes Pterid. 14 (1923) 484. — Type: *Mjöberg 9* (holo P; iso US), Sarawak, Mt Murud, alt. 5000–6000 ft, 1922-1923.

Plagiogyria rotundipinnata Bonap., Notes Pterid. 14 (1923) 484; Copel., Philipp. J. Sc. 38 (1929) 395. — Type: *Mjöberg 7* (holo P; iso K, photogr. BM, PE), Sarawak, Mt Murud, summit, alt. 8000 ft, 1922-1923.

Plagiogyria clemensiae Copel., Philipp. J. Sc. 38 (1929) 395, pl. 4; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 225; Tagawa, Acta Phytotax. Geobot. 26 (1974) 113; Parris et al., Pl. Mount Kinabalu 1 (1992) 97. — Type: *Clemens 10589* (holo MICH-Herb. E.B. Copeland No. 26, fragm. BM-Herb. C. Christensen; photogr. GH, NY, PE), Borneo, Mt Kinabalu, Paka Cave, alt. 3000 m, 12/14-XI-1915.

Rhizome short to c. 15 cm long, erect to decumbent, narrow and very woody. *Stipes* of sterile fronds (6–)10–35(–45) cm long, of fertile fronds 22–55(–66) cm long, the

base strongly or moderately enlarged, 4–20 mm wide in the middle, cross section one U-shaped vascular bundle (but in smaller plants more like a V-shaped form), upper part of stipe tetragonal, aerophores present on stipe and rachis, slender, hook-shaped, with pointed apex (usually short). Fronds usually covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis usually semiterete, trigonous, grooved, or sometimes flattened, rachis 1–2(–4) mm wide in the middle part. *Sterile lamina* rather thin to rather thick, lower part pinnate, upper 1/3 to 1/2 pinnatifid to pinnatifid except a few free basal pinnae (or pinnatifid, the Kinabalu high elevation population), widest medially to subbasally, (10–)20–50(–66) by 5–18(–22) cm, index 2–4; pinnae 20–40(–60) pairs, widest medially (usually, rarely widest at the base in the pinnatifid form), veins of pinnae simple or paired at base or forked above base (few veins), distinct on both surfaces, margin entire (usually completely) or except the apex, most pinnae except the uppermost with equilateral base, cuneate, rounded, attenuate, or acroscopic side adnate; lowermost pinnae sessile to shortly stalked or rarely adnate but slightly constricted, usually slightly deflexed, abruptly or slightly shortened; middle pinnae (3–)4–10(–20) cm long, (0.4–)0.6–0.9(–1.4) cm wide in the middle, sessile to rarely shortly stalked, basiscopic side rounded, partly free from rachis, perpendicular to rachis, or round, base cuneate or rounded (sometimes attenuate); uppermost pinnae adnate, base unequal- to about equal-sided, basiscopically decurrent into rachis wing or rarely rounded; apex of lamina pinnatifid, terminated by a pinnatilobed, short-triangular to pinnatilobed, long-triangular or pinna-like segment (very rare, up to 10 cm long, base connected with upper shorter lateral pinnae). *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis semiterete, flattened, or grooved, rachis 1–2(–5) mm wide in the middle part; lamina pinnate except the apex, lower pinnae shortly stalked, (8–)20–45(–65) by (3–)7–20(–26) cm; pinnae usually sparsely bearing short glandular hairs or glabrous, 15–50(–72) pairs, margin entire or subentire; 1–2(–4) cm apart; middle pinnae 4–11(–16) cm long, 2–3 mm wide, base sessile to shortly stalked; apex pinnatifid, acuminate or caudate, or terminated by a pinna-like segment, or rarely by a pinna conform to the lateral ones and often beaded at the base. Paraphyses many, yellow to dark brown. *Spores* yellow, with reddish tubercles.

Distribution — *Malesia*: Borneo, Philippines, Sulawesi, Moluccas (Seram).

Habitat — A common constituent in mossy forest, in deep shade, rarely epiphytic on moss-covered tree trunks; altitude 1200–4000 m.

d. var. *sumatrana* (Rosenst.) X.C. Zhang & Noot.

Plagiogyria egenolfioides (Baker) Copel. var. *sumatrana* (Rosenst.) X.C. Zhang & Noot., *Blumea* 42 (1997) 484. — *Plagiogyria sumatrana* Rosenst., Feddes Repert. Spec. Nov. Regni Veg. 13 (1914) 214; Alderw., *Malayan Ferns Suppl.* 1 (1916) 244; Bull. Jard. Bot. Buitenzorg III, 2 (1920) 164; Copel., *Philipp. J. Sc.* 38 (1929) 392. — Type: *Winkler in Rosenstock, Filic. Sumatra Ex. 127* (BM, K, L, P), Sumatra, Batakland, 1911.

Plagiogyria subrigida Alderw., Bull. Jard. Bot. Buitenzorg III, 2 (1920) 163. — Syntypes: *Bünnemeijer 4122* (K, L, U), Sumatra, Mt Malintang, alt. 2000 m, 29-VII-1910; *Lörzing 6006* (L), Sumatra, Mt Sibajak, alt. 2000 m, 28-VIII-1910.

Plagiogyria integripinnata Bonap., *Notes Pterid.* 14 (1923) 60. — Type: *Haniff & Nur 8144* (holo P), Malaya, Gunung Tahan, alt. 5500 ft, 11-VI-1922.

Plagiogyria malayensis R.D. Dixit & A. Das, Fern Gaz. 12 (1981) 182, fotogr. 1. — Type: Wray 317 (holo CAL; iso BM), Malaya, Peninsula, Perak, summit of Gunung Batu Puteh, 6700 ft. Paratype: Scortechini 397 (CAL), Malaya, Peninsula, without exact locality.

Plagiogyria tahanensis Miyamoto & H. Ohba, Acta Phytotax. Geobot. 43 (1992) 31, f. 1: A–H. — Type: Miyamoto 89-373 (holo TI), Malaya, Pahang, summit of Gunung Tahan, alt. 1600 m.

Plagiogyria tuberculata auct. non Copel.: Holttum, Revis. Fl. Malaya, ed. 2 (1966) 111; A.G. Piggott, Ferns of Malaysia in Colour (1988) 88, fotogr. 252–255; Miyamoto & H. Ohba, Acta Phytotax. Geobot. 43 (1992) 32, f. 1: I.

Rhizome short to c. 15 cm long, erect to decumbent, narrow and very woody. *Stipes* of sterile fronds (2–)12–30(–40) cm long, of fertile fronds (4–)24–45 cm long, base strongly enlarged, 3–15 mm wide in the middle, cross section one U-shaped vascular bundle, upper part of stipe tetragonal, aerophores present on stipe and rachis (sometimes absent on stipe, and not prominent), slender, hook-shaped, with pointed apex (usually). Fronds covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis grooved (usually), flattened, semiterete, or trigonous, rachis (0.5–)2–3(–5) mm wide in the middle part. *Sterile lamina* rather thick, pinnate except the pinnatifid or pinnatilobed apex or lower part, upper 1/3 to 1/2 pinnatifid, widest medially to subbasally, (5–)30–60(–100) by (2.5–)13–22(–27) cm, index (1.68–)2–3.85(–6.13); pinnae (6–)17–39 pairs, widest below or about the middle, veins of pinnae simple to, rarely, as many as forked, distinct to obscure on both surfaces, margin entire or rarely serrulate, most pinnae except the uppermost with equilateral to inequilateral base, cuneate to rounded; lowermost pinnae shortly stalked (sometimes stalk up to 1 cm long), not deflexed, gradually to abruptly shortened (2 or 3 pairs); middle pinnae (1.5–)6–14 cm long, (0.4–)0.7–1.4(–1.9) cm wide in the middle, sessile to shortly stalked, base rounded or cuneate; uppermost pinnae adnate, base unequal-sided, basiscopically decurrent into rachis wing or rounded; apex of lamina pinnatifid or terminated by a pinna-like (2–7 cm long) or pinnatilobed, long-triangular segment, rarely terminated by a pinna conform to lateral ones with free base, shortly stalked, 11 cm long. *Fertile fronds* usually longer than sterile ones, dorsal side of rachis grooved, flattened, or semiterete, rachis 1–4(–5) mm wide in the middle part; lamina pinnate, pinnae stalked, uppermost pinnatifid, pinnae base decurrent, (12–)35–60(–100) by (2–)9–15(–30) cm; pinnae sparsely bearing short glandular hairs or glabrous, 16–30 pairs, margin erose; lowermost pinnae not shortened (short to long stalked, rarely one or two pairs shorter), (2–)4(–8) cm apart; middle pinnae (2.5–)7–13(–22) cm long, (3–)4–5(–6) mm wide, base shortly stalked; apex pinnatifid, terminated by a pinna-like segment (usually 2–4 cm long). Paraphyses many, dark brown or yellow. *Spores* brown, with reddish tubercles.

Distribution — *Malesia*: Sumatra, Peninsular Malaya.

Habitat — Common in open forest and low scrub, on rather dry soil, in light shade, also on rocks in fairly open places; altitude 1000–2500 m.

3. *Plagiogyria euphlebia* (Kunze) Mett.

Plagiogyria euphlebia (Kunze) Mett., Farngatt. II (1858) 274; Bedd., Handb. Ferns Brit. India (1892) 129; Ridl., J. Malayan Branch Roy. Asiat. Soc. 4 (1926) 35; Copel., Philipp. J. Sc. 38 (1929) 387. — *Lomaria euphlebia* Kunze, Bot. Zeitung (Berlin) (1848) 521. — Syntypes: Göring 128 (Herb. Römer); Zollinger in Herb. Zollinger & Moritz No. 1 (L), Japan.

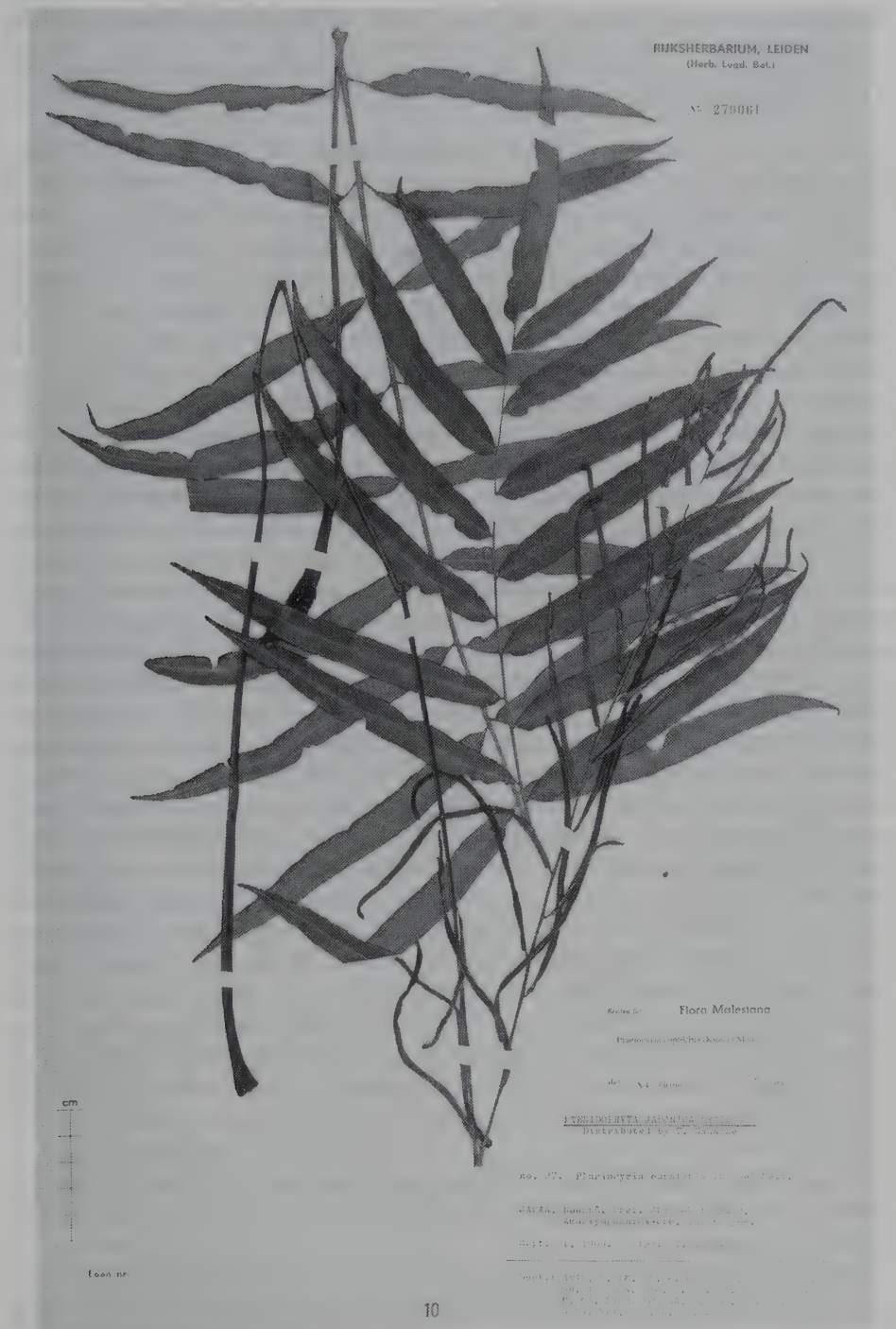


Fig. 3. Herbarium sheet of *Plagiogyria euphlebia* (Kunze) Mett. in L.

Plagiogyria christii Copel., Philipp. J. Sc. 1, Suppl. (1906) 153; Philipp. J. Sc., Bot. 2 (1907) 133; Alderw., Malayan Ferns (1908) 342, 826; Copel., Philipp. J. Sc. 38 (1929) 388; Fern Fl. Philipp. 2 (1960) 194; R.D. Dixit & A. Das, Proc. Indian Acad. Sci. (Plant Sci.) 90 (1981) 375, photogr. 2. — Type: *Copeland 1509* (MICH, n.v.), Philippines, Mt Apo, 1500–1800 m.

Rhizome short, erect to decumbent, narrow, sometimes very woody. *Stipes* stramineous to brownish, of sterile fronds (7–)25–35(–70) cm long, of fertile fronds (9–)40–77 cm long, base slightly to strongly enlarged, 5–10(–20) mm wide in the middle, in cross section one V-shaped to one U-shaped vascular bundle, upper part of stipe terete or oval (usually) or tetragonal, aerophores only present on base of stipe or seemingly absent at dry stage, present on base of stipe and lower part of rachis, or present on stipe and rachis, cushion-like; rachises glabrous to hairy to sometimes densely hairy. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete (usually), flattened or grooved, not winged, rachis 1–2(–5) mm wide in the middle part. *Sterile lamina* herbaceous to firm herbaceous to subcoriaceous (very rare, found near the sea), not glaucous, pinnate, apical pinna base free, or sometimes connected with upper lateral ones, or rarely pinnate except the pinnatifid or pinnatilobed apex, widest basally to medially, (11–)20–60(–136) by (7–)12–30(–40) cm, index 1.36–2.5(–3.8); pinnae 7–25 pairs, widest medially, veins of pinnae simple to as many as forked, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate or towards the base becoming entire or nearly so, most pinnae except the uppermost with equilateral, cuneate, rounded, or attenuate base; lowermost pinnae shortly stalked or rarely sessile, not deflexed, not or slightly shortened (the basal pair); middle pinnae (5–)11–17(–30) cm long, 0.9–2(–2.6) cm wide in the middle, shortly stalked or sessile, base cuneate or rounded; apex of lamina terminated by a pinna conform to lateral ones or rarely pinnatifid, base with 1–3 irregular auricles or free, shortly stalked, or connected with 1 or 2 shorter lateral pinnae (sometimes connected with more than 2 pairs), (4–)7–10(–30) cm long, terminated by a pinnatilobed, short-triangular or pinna-like segment. *Fertile fronds* usually longer than the sterile ones, rarely shorter or about the same length, dorsal side of rachis semiterete (usually), flattened, or grooved, not winged, rachis 1–2(–5) mm wide in the middle part; lamina pinnate throughout, pinnae shortly stalked or nearly sessile, (9–)20–50(–80) cm long, (3–)10–20(–33) cm wide; pinnae glabrous or sparsely bearing short glandular hairs, 7–25 pairs, margin entire, subentire, or erose; lowermost pinnae not shortened (or the basal pair shorter), (1–)4–6(–8) cm apart; middle pinnae (2–)7–20(–33) cm long, 2–4(–5) mm wide, base shortly stalked to sessile; apex terminated by a pinna conform to the lateral ones and often beaded at the base. Paraphyses many, brown. *Spores* yellow or brown, with reddish tubercles. — **Fig. 3.**

Distribution — Japan, China (Anhui, Zhejiang, Fujian, Hubei, Hunan, Guangdong, Guangxi, Jiangxi, Taiwan, Sichuan, Guizhou, Yunnan), Nepal, India, Burma, Vietnam; *Malesia*: Philippines.

Habitat — In forest; altitude 50–2500 m, usually 600–1500 m; in Japan 50–650 m.

Chromosome number — Kurita [J. Coll. Arts Sci. Chiba Univ. Nat. Sci Sér. 4 (1963) 43 and Tsai [J. Sc. Engin. 10 (1973) 261] reported $n = c. 125$, and $n = 125$; Nakato and Mitui [J. Jap. Bot. 58 (1983) 105] reported $2n = 260$.

4. *Plagiogyria falcata* Copel.

Plagiogyria falcata Copel., Philipp. J. Sc., Bot. 2 (1907) 133, pl. 1, f. B; Alderw., Malayan Ferns (1908) 826; Hayata, Icon. Pl. Formos. 4 (1914) 239; Copel., Philipp. J. Sc. 38 (1929) 400; Fern Fl. Philipp. 2 (1960) 196; K. Iwats. & M.G. Price, South East Asia Studies 14 (1977) 549. — Type: Merrill 5960 (MICH, P), Philippines, Mindoro, Mt Halcon, alt. 2100 m, XI-1906.

Rhizome short to c. 15 cm long, suberect, narrow or thick with many stipe bases. *Stipes* stramineous, of sterile fronds (6–)12–20(–30) cm long, of fertile fronds 20–45 cm long, base slightly or moderately enlarged, 4–6(–8) mm wide in the middle, in cross section one V-shaped vascular bundle, upper part of stipe (sharply) triangular, aerophores only present on base of stipe; rachises glabrous. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis carinate, not winged (or winged on the sharp ridge), rachis 1–2 mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnatifid, widest medially, (10–)20–40(–55) by (3–)5–13(–17) cm, index (2.5–)3–4(–5.4); pinnae (12–)35–53 pairs, widest near base, veins of pinnae paired at base, forked above base to paired at base, or branched at base, both branches forked above or rarely simple, distinct on both surfaces, stomata scattered on lower epidermis, margin serrulate, sometimes towards base becoming entire or nearly so, or entire except apex (rarely biserrulate to the apex), most pinnae except the uppermost with (nearly) inequilateral base, adnate to rachis; lowermost pinnae adnate, deflexed (usually), not shortened to abruptly shortened; middle pinnae (1.5–)5–8.5 cm long, 0.4–1 cm wide in the middle, acroscopic side of base adnate to the rachis but not into a wide wing, basiscopic side perpendicular to rachis or rounded, partly free from rachis or round; uppermost pinnae adnate, base about equal-sided, basiscopically perpendicular to the rachis; apex of lamina pinnatifid, terminated by a pinnatilobed, long-triangular segment. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis carinate, rachis 1.5–2.5 mm wide in the middle part; lamina deeply pinnatifid, rachis slightly winged throughout, 20–50 by 3–6 (–10) cm; pinnae glabrous, (15–)35–50 pairs, margin subentire; lowermost pinnae not or gradually shortened (sometimes not well developed), 2–3 cm apart; middle pinnae (1–)2.5–5 cm long, 2–4 mm wide, base broadly adnate; apex pinnatifid, acuminate, or caudate. Paraphyses few, mostly lost or absent, yellow. *Spores* yellow, with reddish tubercles. — **Fig. 4.**

Distribution — China (Anhui, Zhejiang, Fujian, Jiangxi, Hunan, Guangdong, Guangxi, Hongkong, Hainan, Taiwan, Guizhou); *Malesia*: Philippines.

Habitat — In dense ravine forest, or under shade rocks, altitude 40–2150 m, usually 500–1500 m.

5. *Plagiogyria glauca* (Blume) Mett.

Plagiogyria glauca (Blume) Mett., Farngett. II (1858) 273; Bedd., Ferns Brit. India 1 (1866) pl. 90; Kuhn, Ann. Mus. Bot. Lugd-Bat. 4 (1869) 291; Alderw., Malayan Ferns (1908) 342; Copel., Sarawak Mus. J. 2 (1917) 388; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 225; Backer & Posth., Varenfl. Java (1939) 31; Copel., Fern Fl. Philipp. 2 (1960) 195; Holttum, Revis. Fl. Malaya ed. 2 (1966) 112; Parris et al., Pl. Mount Kinabalu 1 (1992) 97. — *Plagiogyria glauca* subsp. *glauca* Nakaike, Bull. Nat. Sc. Mus. Tokyo 14 (1971) 264. — *Lomaria glauca* Blume, Enum. Pl. Javae (1828) 204; Moritz, Syst. Verz. (1844) 112. — Lectotype: *Blume s.n.* (L sh. 908.316-285), Java, Salak.



Fig. 4. Herbarium sheet of *Plagiogyria falcata* Copel. in NY.

- Lomaria glauca* var. *B* Blume, Enum. Pl. Javae (1828) 204. — Lectotype: *Blume s.n.* (L sh. 908.316-284).
- Plagiogyria glauca* var. *philippinensis* H. Christ, Bull. Herb. Boiss. 6 (1898) 150; Copel., Polypod. Philipp. Is. (1905) 98; Alderw., Malayan Ferns (1908) 342. — Type: *Loher s.n.* (P), Philippines, Mt Data, XI-1893.
- Plagiogyria nana* Copel., Philipp. J. Sc., Bot. 4 (1909) 114, non Fée ex Salomon (1883); Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Philipp. J. Sc. 38 (1929) 393; Fern Fl. Philipp. 2 (1960) 195. — *Plagiogyria glauca* var. *nana* C. Chr., Brittonia 2 (1937) 284. — Syntypes: *FB 16306* (MICH), *PPE-113* (BM, K, L, PE, P, NY, US), Luzon, Benguet, Mt Pulog, alt. 2850 m, V-1909.
- Blechnum papuanum* Brause, Bot. Jahrb. Syst. (1920) 158. — *Plagiogyria papuana* Alston, J. Bot. (1939) 290, non C. Chr. (1937). — *Struthiopteris papuana* Ching, Sunyatsenia 5 (1940) 243. — *Plagiogyria brausei* Nakaike, Bull. Nat. Sc. Mus. Tokyo 17 (1991) 90. — Type: *Ledermann 11978* (holo B; fragm. BM, photogr. BM, PE), Papua New Guinea, Sepik, alt. 2070 m, 3-VI-1913.

Rhizome short to c. 15 cm long, erect, suberect to curved, or decumbent, narrow and very woody or thick with many stipe bases. *Stipes* stramineous or brownish, of sterile fronds 3–55 cm long, of fertile fronds 5–75 cm long, base strongly enlarged, 5–15 mm wide in the middle, in cross section one U-shaped vascular bundle, upper part of stipe tetragonal, terete, or oval, aerophores present on stipe and rachis, elongate, horn-like with blunt apex; rachises glabrous to hairy or sometimes densely hairy. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete to flattened or grooved, not winged, rachis 0.5–4 mm wide in the middle part. *Sterile lamina* firm herbaceous or subcoriaceous, glaucous beneath, pinnate except the pinnatifid or pinnatilobed apex, widest medially or a little higher, 7–110 by 2–30 cm, index (1.8)–2.8–3.8(–4.6); pinnae 13–43 pairs, widest below or about the middle to near the base, veins of pinnae as many simple as forked, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate, most pinnae except the uppermost with equilateral base, truncate or rounded; lowermost pinnae sessile to shortly stalked, not or slightly deflexed, abruptly shortened or not, some pinnae vestigial on stipe sided by aerophores; middle pinnae 1–15.5 cm long, 0.6–1.8 cm wide in the middle, sessile, base truncate or rounded (at dry stage); apex of lamina pinnatifid, terminated by a pinnatilobed segment or by a pinna conform to lateral ones, base connected with 1 or 2 shorter lateral pinnae or rarely with 1–3 irregular auricles, 1–10 cm long. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis semiterete, flattened, or grooved, not winged, rachis 0.5–4 mm wide in the middle part; lamina pinnate throughout, pinnae shortly stalked or nearly sessile, 11–77 by 4–24 cm; pinnae glabrous, 13–43 pairs, margin subentire to erose; lowermost pinnae gradually shortened or some pairs aerophore-like vestiges on stipe together with aerophores, 2–4 cm apart; middle pinnae 2–14 cm long, by 2–4.5 mm wide, base shortly stalked, sessile, or slightly cordate; apex pinnatifid, acuminate or caudate. Paraphyses few, mostly lost, dark brown or yellow. *Spores* yellow to brown, not obviously tuberculate.

Distribution — China (Taiwan, Xizang, Yunnan), India (Assam, Khasia and Jaintea Hills, Manipur, Naga Hills), North Burma; *Malesia*: Sumatra, Java, Lesser Sunda Islands (Flores), Borneo (Mt Kinabalu), Philippines (Luzon, Mindanao), Sulawesi, Moluccas (Seram), New Guinea, S New Ireland, Solomon Islands (Guadalcanal).

Habitat — In light shade or open places, grasslands; altitude 1200–3800 m.

Chromosome number — Walker [J. Linn Soc. Bot. (London) 67, Suppl. 1 (1973) 91] reported $n = c. 132$; Tsai [J. Sc. Engin. 10 (1973) 261] reported $n = 75$, under the name of *Plagiogyria formosana* Hayata.

Note — Clarke (1880) considered this to be only a variety of *P. pycnophylla*, and correctly pointed out that some of the Javanese specimens are much larger than those from Khasia. M.G. Price (pers. comm.) informed us that *P. glauca* and *P. pycnophylla* grow together in the Philippines. *Plagiogyria glauca* and *P. pycnophylla* coexist in most of their area of distribution except in Sichuan (the northern limit of *P. pycnophylla*), S Yunnan to Thailand, Indochina and Peninsular Malaya where *P. glauca* is absent, and in Taiwan where the other is wanting. The Taiwan population of *P. glauca* is rather constant with a terminal pinna. Perhaps *P. glauca* is distinguished from *P. pycnophylla* only because of the very obvious white wax under the laminae. However, when the wax is lost on herbarium specimens, probably the name *P. pycnophylla* will be given. In this case, the suggestion is to use a binocular to trace the white colour at the recurved pinna margins (the same situation applies to *P. assurgens*, another glaucous *Plagiogyria*).

The function of the wax is not well clear for this kind of ferns, mainly distributed in humid mountain forests. Certainly it protects the stomata from losing much water during the dry season of year.

6. *Plagiogyria pycnophylla* (Kunze) Mett.

Plagiogyria pycnophylla (Kunze) Mett., Farngatt. II (1858) 272, t. 4, f. 22; Bedd., Ferns Brit. India 1 (1865) pl. 52; Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 291; Copel., Philipp. J. Sc. 1, Suppl. (1906) 154; Sarawak Mus. J. 2 (1917) 388, p.p., excl. var. *integra*; Ridl., J. Malayan Branch Roy. Asiat. Soc. 4 (1926) 36; Copel., Philipp. J. Sc. 38 (1929) 390; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 224; Backer & Posth., Varenfl. Java (1939) 31; Copel., Fern Fl. Philipp. 2 (1960) 194; Parris et al., Pl. Mount Kinabalu 1 (1992) 97. — *Lomaria pycnophylla* Kunze, Bot. Zeitung (Berlin) 6 (1848) 143; Hook., Sp. Fil. 3 (1860) 21, t. 148; Racib., Pteridoph. Buitenzorg 1 (1898) 161. — *Stenochlaena* ? *pycnophylla* C. Presl, Epim. Bot. (1851) 165. — [*Lomaria scandens* De Vriese ex Hook., Sp. Fil. (1860) 22, nom. nud., pro syn., non Willd.] — Lectotype (proposed here): *van Gesker s.n.* (L sh. 908.325-138), Java, Mt Gede. See note.

Lomaria pycnophylla forma *major* Racib., Pteridoph. Buitenzorg 1 (1898) 162. — Type: *Raciborski s.n.* (L sh. 908.316-303), Java, Mt Gede.

Lomaria pycnophylla forma *alpina* Racib., Pteridoph. Buitenzorg 1 (1898) 162. — Type: *Raciborski s.n.* (L sh. 938.297-304, iso in K, P), Java, Mt Pangerango. See note 3.

Lomaria glauca var. *C* Blume, Enum. Pl. Javae (1828) 204. — Lectotype: *Blume s.n.* (L sh. 908.316-296), Java.

[*Lomaria glauca* var. *concolor* Moritz, Syst. Verz. (1844) 112, nom. nud.] — Voucher: Zollinger 232z (iso L), Java, G. Salak, alt. 2000 m, 2/4-XI-1843.

Lomaria callosa Fée, Mém. Foug. 5. Gen. Filic. (1853) 70. — Type: *Lobb* 274 (holo P, n.v.; iso BM, K), Java, 1847.

Plagiogyria pycnophylla var. *remota* H. Christ, Bull. Herb. Boiss. 6 (1898) 150; Copel., Polypod. Philipp. Is. (1905) 97; Alderw., Malayan Ferns (1908) 343. — Type: *Loher* 953 (holo K), Luzon, Mt Data, alt. 2250 m, II-1894.

Plagiogyria pycnophylla var. *mixta* Copel., Philipp. J. Sc. 1, Suppl. (1906) 154. — Type: *Copeland* 1854 (n.v.) Mt Data, alt. 2000 m.

Plagiogyria wilhelmensis Nakaike, Bull. Nat. Sc. Mus. Tokyo 17 (1991) 93, f. 14. — Type: *Nakaike* 280 (holo TNS, n.v.).

Rhizome short to c. 15 cm long, erect, narrow and very woody. *Stipes* stramineous or brownish, of sterile fronds 6–60 cm long, of fertile fronds 10–70 cm long, base strongly enlarged, 5–15 mm wide in the middle, in cross section one U-shaped vascular bundle, upper part of stipe tetragonal, terete, oval, or triangular, aerophores present on stipe and rachis, elongate, horn-like, with blunt apex; rachises glabrous to hairy to sometimes densely hairy. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis flattened, semiterete or grooved, not winged (or winged on ridges), rachis 1–4 mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnate except the pinnatifid or pinnatilobed apex, widest medially, 15–100 by 6–40 cm, index (1.8–)2.3–2.8(–4.1); pinnae 20–50 pairs, widest near the base or below the middle, veins of pinnae simple or up to half forked, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate, most pinnae (except the uppermost) with equilateral base, truncate or rounded; lowermost pinnae sessile to shortly stalked, slightly deflexed or not, gradually or slightly shortened, some pinnae vestigial on stipe sided by aerophores; middle pinnae 3–20 cm long, 0.6–2 cm wide in the middle, sessile, base truncate or rounded; apex of lamina pinnatifid, terminated by a pinnatilobed segment or by a pinna conform to lateral ones, base connected with 1 or 2 shorter lateral pinnae, 3–7 cm long. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis flattened, semiterete, or grooved, not or sometimes winged on the ridges (slightly, also along the corner line of the stipe); lamina pinnate throughout, pinnae shortly stalked or nearly sessile, 20–70 by 4–20 cm wide; pinnae glabrous, 16–40 pairs, margin erose; lowermost pinnae gradually shortened or some pairs aerophore-like vestiges on stipe together with aerophores, 2–4(–5) cm apart; middle pinnae (3–) 4.5–13(–21) cm long, 2–4 mm wide, base sessile, slightly cordate, or shortly stalked; apex pinnatifid, acuminate or caudate or terminated by a pinna conform to the lateral ones and often beaded at the base. Paraphyses few, mostly lost, dark brown or brown. *Spores* yellow to brown, not obviously tuberculate.

Distribution — China (Sichuan, Yunnan, Xizang), N Burma, Sikkim, Bhutan, Nepal, E India (Assam, Khasia and Jaintea Hills, Manipur); *Malesia*: Peninsular Malaysia, Sumatra, Java, Philippines (Luzon), Borneo (Mt Kinabalu), Sulawesi, New Guinea.

Habitat — In wet places of forest; altitude 1200–3500 m.

Note — Kunze's herbarium at Leipzig was destroyed (Stafleu & Cowan 1979). Gesker's specimen in L is selected as lectotype because it is in accordance with the original material of Kunze from Java that bears the name of "*Lomaria scandens* W." by De Vriese.

7. *Plagiogyria stenoptera* (Hance) Diels

Plagiogyria stenoptera (Hance) Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 282; Copel., Philipp. J. Sc. 1, Suppl. (1906) 154; Alderw., Malayan Ferns (1908) 341; Copel., Fern Fl. Philipp. 2 (1960) 196. — *Blechnum stenopterum* Hance, J. Bot. 21 (1883) 268. — *Lomaria concinna* Baker, J. Bot. 23 (1885) 103, nom. superfl.; Baker in Hook., Icon. Pl. 7 (1886) pl. 1644. — *Lomaria stenoptera* Baker, Ann. Bot. (London) 5 (1891) 40, 220. — Type: *Hancock* 39 (K; iso BM), Taiwan, 'Tamsui District', XI-1881. See note.

[*Plagiogyria auriculifera* Makino, Bot. Mag. (Tokyo) 23 (1909) 244, nom. nud., pro syn.]

Rhizome short, erect to suberect, thick with many stipe bases. *Stipes* stramineous, of sterile fronds (3-)4-8(-12) cm long, of fertile fronds (9-)11-22(-28) cm long, base slightly enlarged, 4-8 mm wide in the middle, in cross section one V-shaped vascular bundle, upper part of the stipe tetragonal, aerophores only present on base of stipe; rachises glabrous. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis flattened or upwards carinate, with crisped wings on the two ridges or not, rachis 1-2 mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnatifid, widest medially, 20-62 by 4-20 cm wide, index (2.6-)3.3-4.3(-5.5); pinnae 25-35 pairs (auricle pinnae excluded), widest near base or medially (in very large forms), veins of pinnae forked above base, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate or towards the base becoming entire or nearly so, most pinnae except the uppermost with inequilateral base, adnate to rachis; 3-6(-11) pairs reduced to mere auricles; middle pinnae 2.5-10.5 cm long, 0.7-1.4 cm wide in the middle, acroscopic side of base adnate to the rachis into a wide wing, basiscopic side like the acroscopic side or round (in large fronds); uppermost pinnae adnate, base about equal-sided, basiscopically decurrent into rachis wing; apex of lamina pinnatifid. *Fertile fronds* usually longer to shorter than the sterile ones, dorsal side of rachis flattened to grooved, sometimes winged on the ridges, rachis 1-2 mm wide in the middle part; lamina pinnate throughout, pinnae nearly sessile or deeply pinnatifid, rachis slightly winged throughout (an abnormal state), (10-)35-55(-75) by 4-8(-12) cm (since pinnae are drooping to one side); pinnae sparsely bearing short glandular hairs (on the inner side), 15-30 pairs (vestigial ones excluded); margin of pinnae entire to subentire; some pairs of lowermost pinnae aerophore-like vestiges on stipe together with aerophores (or sometimes replaced by auricle pinnae like the sterile ones), 2 cm apart; middle pinnae (2.5-)4-6(-12) cm long, 2-3 mm wide, base shortly stalked; apex terminated by a pinna conform to the lateral ones and often beaded at the base. Paraphyses absent. *Spores* yellow, with reddish tubercles.

Distribution — Japan (Yakushima), China (Hubei, Hunan, Guangxi, Sichuan, Taiwan, Guizhou, Yunnan), Vietnam; *Malesia*: Philippines (Luzon).

Habitat — In moist dense mountain forests, or in ravines, rocky slopes; altitude 500-2500 m.

Chromosome number — Tsai [J. Sc. Engin. 10 (1973) 261] reported $n = 75$.

Note — Baker (1885) published *Lomaria concinna* based on *Hancock* 39, which is also the type of *Blechnum stenopterum* Hance (1883).

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M.M.J. van Balgooy



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